



THE SENSOR-BASED ECONOMY

This article is produced by WIRED Brand Lab in collaboration with TE Connectivity.

The tiny electronic sensor is having a big impact on our lives. Every moment of every day these small but essential tech workhorses turn streams of data into life-changing decisions.

The benefits can be enormous. In recent years, sensors have made their greatest mark as the spark plug in the engine of the Internet of Things (IoT). Hundreds of billions of sensors are already embedded in a vast array of networked physical objects, enabling everything from sophisticated health care devices that remotely monitor heart rate and medicine intake to systems that track down lost keys, turn your oven off from your smartphone, or help keep indoor plants alive.

This is just the beginning.

“The next step in this new age of metadata is that we’re going to see patterns that no one knew existed,” says Brian Ream, principal field applications engineer for sensors at TE Connectivity. “Sensors are rapidly bringing us to a place where we can gather, synthesize, and understand enormous amounts of data very quickly.” And, as more intelligent objects become ubiquitous and interlinked, a new world of opportunities will arise from the larger and richer data sets these devices produce. Researchers across a number of industries can potentially provide more accurate predictions and insights tied to the world around us—but only if they’re able to successfully gather and understand the information flowing in.

In emerging economies throughout the world sensor-driven tech can foster socioeconomic development and increase the country’s ability to compete on the world stage. The SWEETLab at Portland State University is working on a number of projects designed to help better life in struggling environments and draw attention to what the lab calls the “Internet of Broken Things.” Their monitors have been used in projects ranging from water pumps in Kenya to cookstoves in India and water filters in Indonesia. Similarly, at small farms in Vietnam, IoT-driven “smart agriculture” is being used to improve production efficiency, protecting farms against pests and weather fluctuations, and raise the quality of what’s grown. Sensors monitor irrigation levels, fertilizer disbursement, and temperature fluctuations, as well as cut costs and the risk of disease.

To many experts, those meta developments are the most exciting developments in sensors. “It’s easy to get excited about the new developments in leading-edge sensor technology, but then you’d be missing the big picture,” says Chris Curran, chief technologist at PricewaterhouseCoopers. “The real advantage—and the greatest challenge—is going to come from using the data and getting value from the information you’re collecting. Those are the keys to this kingdom.”

A Billion Paths to Insight

The goal of any sensor is pretty simple: gather information (vibration, temperature, pressure, voltage) that can be fed into algorithms and analytics for better real-time decision-making. The more data the sensors gather, the better the real-time analysis of that info. Sensors were initially developed for large and expensive industrial platforms, such as jet engines, to help discover faulty parts in products weeks before they actually fail. “Most sensor applications started in safety systems,” says Steve Merkt, president of transportation solutions at TE Connectivity. “Then they find their way into other industries.”

Researcher estimates say there will be nearly 6.4 billion connected objects this year, up 30 percent from 2015 and growing to reach 20.8 billion by 2020. IoT is on track to connect 50 billion “smart” things by 2020 and 1 trillion sensors soon after, according to the National Science Foundation.

Sensor-equipped devices are already generating an enormous amount of data. Industry experts estimate that we create as much information every day as was generated from the dawn of civilization to 2003. Some experts even believe that 90 percent of the world’s data has been created in the past two years alone. Now more than ever, real-time analytics have become essential as data-fueled insights continue to highlight new efficiencies in how we work and manufacture goods.

“In many ways we are looking at a sensor-based economy,” says Bob Brumley, managing director of Pegasus Global Holdings, a tech development firm out of Washington. “Sensors are becoming a platform on which we can build a whole range of opportunities.”

How are these new opportunities taking shape? We spoke with a number of experts to find out.

Home Health Care

Sensors are already well established in the world of medicine, where they are used daily in many hospitals to monitor information critical to equipment operation and patient care. In dialysis equipment, for example, pressure, force, and temperature sensors monitor the critical parameters that help keep patients’ blood pumping.

Sensors are also part of a larger trend of moving health care into the home, in part because nearly 13 million seniors live alone in the United States, according to ClearCare, a San Francisco-based maker of software for home care agencies. Medical companies hope these sensor-based devices will allow the elderly to maintain their independence longer, reducing the costs associated with professional caretakers. These tools can take a number of forms: pill bottles that know whether they’ve been opened, socks that track a person’s gait, devices under pillows that record how many hours someone has slept, even small stickers on the skin that keep tabs on body temperature. This critical info will be relayed back to a clinician who can respond if something does not seem quite right.

Similar monitoring can be done on the fly for anything from blood pressure to glucose level, heading off potentially damaging or fatal events.

“The human body is already like a supercomputer, with sensory inputs from everywhere,” Ream says. “Soon, we’ll be able to measure things that we don’t even know the body is doing. The more of these that we can capture and measure, the better snapshot we have of a patient’s health.”

Other sensor-driven products may also play a part in improving mental health. Designer and maker Chloe Meineck has created the Music Memory Box, a device to help people living with dementia. Users attach RFID tags to familiar objects, such as an old award or a small gift that was received. When an object is placed in the center of the Music Memory Box, a reader picks up the individual RFID number and plays the appropriate music or sounds, perhaps stirring otherwise inaccessible memories in the patient. Meineck’s project draws on medical research that shows that recall in people with dementia may be triggered by music, especially a song or piece from the patient’s past.

Transportation

The autonomous self-driving car is sexy, no question. But while it’s capturing headlines for its sci-fi appeal, it’s also pushing the frontiers of sensor-based technologies to make driving safer and more efficient. That’s because of its reliance on lidar (light radar) sensors, which map the vehicle’s surroundings in 3-D by bouncing laser light off nearby objects to detect them and determine their proximity. Lidar has a much shorter range than radar, but the shorter wavelengths result in a massive increase in resolution. Many autonomous cars use a lidar sensor that scans 2.2 million data points in its field of view each second and can pinpoint the location of objects up to 120 meters away with accuracy to the centimeter.

In the case of autonomous vehicles, wireless communication connects vehicles to one another and allows monitoring of surroundings, including pedestrians and bicyclists. The result: improved safety. U.S. federal transportation agencies may require all new cars to have sensor-enabled vehicle-to-vehicle transportation, known as V2V, as early as fall 2017.

Building a better city

Cities can be a tough place to live. They're noisy, crowded, stressful. But they don't have to always be that way.

Sensors are making big inroads in health and stress reduction in urban environments. London entrepreneurs, for instance, are experimenting with a sensor-based monitoring system which is designed to help people exposed to constant loud aircraft noise, known to increase the risk of cardiovascular disease. The system collects noise data from a network of sensors near airports to raise awareness about the possible health risks of prolonged exposure to the din of airplane engines. The creators say they hope to use the evidence they gather to fight the construction of a third runway at Heathrow.

But perhaps the biggest and most futuristic project takes place in a city that isn't really a city at all. The Center for Innovation, Testing and Evaluation (CITE) is a faux city being developed in the New Mexico desert about 60 miles north of the Mexican border. Created by Pegasus Global Holdings, CITE is designed to resemble a modest American town with a population of 35,000 spread over roughly 15 square miles. It will include tall office buildings, narrow alleys, parks, houses, churches, a simulated interstate highway, a gas station, and even a big-box store. But no one will live there.

The goal of CITE is to provide an opportunity to test large-scale and interconnected sensor-based tech experiments in real-world conditions. Experiments could revolve around intelligent transportation systems (such as A.I.-enabled traffic management and roads filled with driverless delivery vehicles), alternative-energy power generation (including solar and geothermal), smart grid technologies, and experiments in data collection, sensors, public monitoring, security, and computer systems.

"We're trying to create an expansive and immersive sensor-based operating environment that will show the ripple effect, how one system affects others," says Brumley. "Once you have everything connected, that's when things begin to get really interesting."

Whether in health care, city planning or transportation, sensors are playing a key role in a new era of global efficiency, centered on machines that learn and make predictions. As more devices find new life and efficiency through sensors, it will be up to the next generation of engineers, innovators, and artists to tap into the nearly endless opportunities that our data-filled world present. By monitoring and marshaling the enormous data that sensors generate, we can make smarter decisions that make life healthier and more enjoyable.

Beneath this new interconnected world is the complex web of machine-to-machine communication. For an in-depth look at the language connecting tomorrow's devices, check out Inside the Tech Powering the Next Industrial Revolution, brought to you by TE Connectivity.

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