

## **New Sensor Types with Healthcare Diagnosis and Monitoring Capabilities**

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Wearable devices like the Fitbit or Apple Watch have gained traction in recent years. These companies and users have touted the health and activity monitoring features of these devices, such as heart rate monitoring and step counting. The data is often further linked to smartphone and computer applications that engage and empower the user to take control of their activity regimen in new ways, and even share data with healthcare providers.

Looking forward, the use of sensors and software applications appears to be moving well beyond wearable devices and the tracking of a few key vitals. Internal sensors of various types are showing promise in collecting data to support medical diagnoses and treatment.

### **The Ingestible Gut Sensor and Medical Diagnoses**

A study published in the Journal *Science* in late May provided details on an ingestible sensor tested in pigs that can detect gastrointestinal and stomach issues.<sup>1</sup> Co-author of the study, Timothy Lu, a bioengineer at the Massachusetts Institute of Technology noted, “If you’re over 50, you’re supposed to go to the doctor and get a colonoscopy, but what if you could swallow a pill that tells you early signs of infection?”<sup>2</sup>

The MIT team is currently working to reduce the size of the gut sensor (currently about the size of a pen cap) before testing it in humans.<sup>3</sup> But, the early testing in pigs has shown success. The principal is quite basic. The sensory device is filled with genetically modified bacteria that is capable of detecting the blood compound called heme. When detected, the bacteria glows. The sensor detects the glowing of the bacteria and then pings a smartphone app with this information. Of course, the device contents could be modified in order to detect other compounds.

### **The Implantable Sensor and Physical Therapy Treatment**

Another study that was published in Nature Electronics in May discusses an ‘implantable pressure and strain sensor’... ‘designed to degrade after its useful lifetime, eliminating the need for a second surgery to remove the device’.<sup>4</sup> Based on a study in rats, the scientists involved have determined ‘applicability of the device to the real-time monitoring of tendon healing’.<sup>5</sup>

In practice, the small sensor (about a third of an inch long), could greatly assist with physical therapy treatment. Study co-author Paige Fox, a professor of reconstructive surgery at Stanford University,

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<sup>1</sup> Mimeo, Mark *et al.* *An ingestible bacterial-electronic system to monitor gastrointestinal health.* Science. May 25, 2018. Available at: <http://science.sciencemag.org/content/360/6391/915.full>. Accessed on May 30, 2018.

<sup>2</sup> Chen, Angela. How sensors are giving us another way to peek inside our bodies. The Verge. May 25, 2018. Available at: <https://www.theverge.com/2018/5/25/17394806/sensor-gut-hand-teeth-biology-disease-health>. Accessed on May 30, 2018.

<sup>3</sup> *Ibid.*

<sup>4</sup> Boutry, Clementine M. *et al.* *A stretchable and biodegradable strain and pressure sensor for orthopaedic application.* Nature Electronics. May 14, 2018. Available at: <https://www.nature.com/articles/s41928-018-0071-7>. Accessed on May 30, 2018.

<sup>5</sup> *Ibid.*

explained that by measuring strain and pressure, it ‘can help patients with their rehabilitation programs’.<sup>6</sup> “Being told to ‘use your hand at half-strength’ or ‘bend your tendon 30 degrees’ can seem subjective and confusing. A sensor that collects this info and sends it to a smartphone could give more useful feedback — like ‘use more strength’ — that speeds the recovery process.”<sup>7</sup>

### **Going Forward**

In her article, ‘How sensors are giving us another way to peek inside our bodies’, *The Verge* author Angela Chen discussed these and other sensors that can be either swallowed or implanted. Other types included an ingestible sensor approved by the US Food and Drug Administration that can detect whether patients have taken their medications, and a tooth-mounted sensor that can detect chemicals in saliva and relay this information to a smartphone.<sup>8</sup>

Much of the work on these new ingestible and implantable sensors is academic. But, it’s plain to see the value in collecting and relaying the data from inside our bodies to smart applications for the purposes of medical diagnosis and treatment. It’s likely that these sensory devices will come to play a significant role in the healthcare field going forward; and, perhaps even in our daily lives.

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<sup>6</sup> Chen, Angela. *Op cit.*

<sup>7</sup> *Ibid.*

<sup>8</sup> *Ibid.*