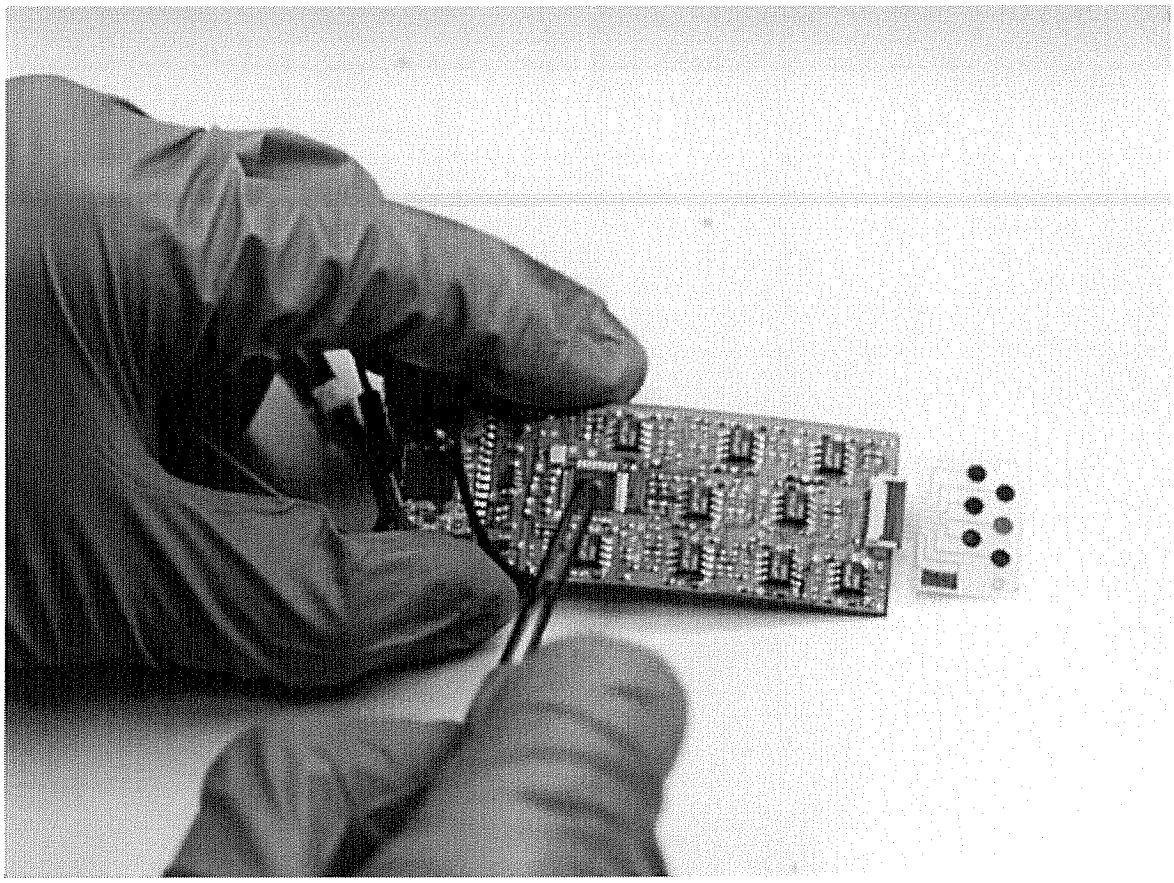
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For new wearable, monitoring health at the molecular level is no sweat

By wicking up perspiration, device tracks multiple molecules in real time.

by Beth Mole - Jan 27, 2016 8:00pm EET

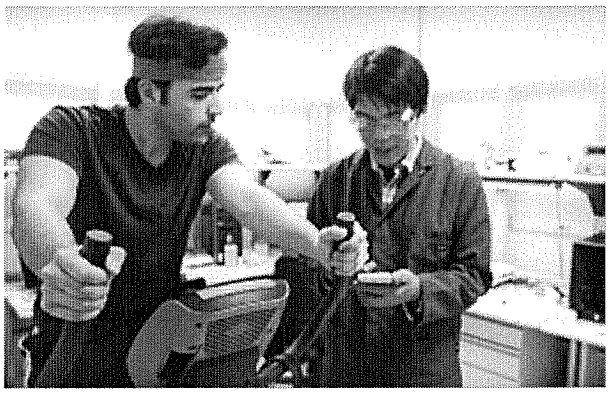


To get a detailed work up on your health, soon all you might have to do is work up a little sweat. A new wearable device that soaks in tiny volumes of perspiration from your brow or wrist can track multiple molecules leaking out of you in real-time, researchers report in *Nature.* The device could one day provide up-to-the-moment health reports, helping to spot conditions such as dehydration, chemical exposures, muscle fatigue, and chronic stress, and help manage diseases, such as diabetes, the authors suggest.



"Sweat is very rich in information about an individual's health," lead author of the study Ali Javey, of University of California, Berkeley, told Ars. "It has a lot of different chemicals in it, different proteins,

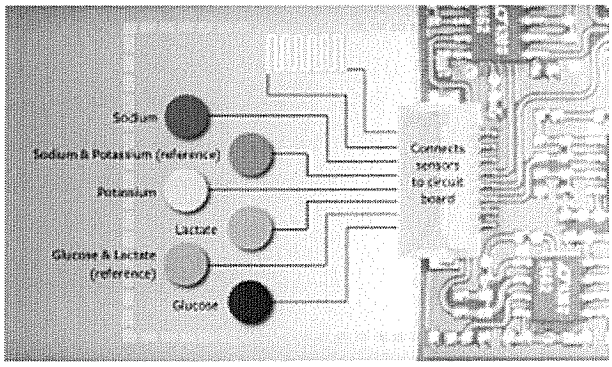
different metabolites, electrolytes," he said. And by monitoring the concentration of some of those chemicals in beads of sweat, researchers can glean useful health information.



For their first generation of sweat-scanning wearables, Javey and colleagues set up an array of off-the-shelf sensors that track sodium, potassium, glucose, lactate, and temperature. Monitoring electrolytes such as sodium and potassium may help track conditions like dehydration, Javey said. Lactate levels may be useful for tracking muscle fatigue, and glucose may help monitor blood sugar levels.

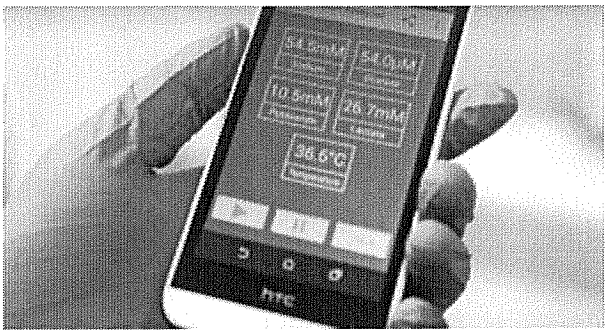
The sensor array, about the size of a quarter, is disposable—good for about one workout. Behind it, there's a sweat-wicking pad that can take in about ten microliters of perspiration at a time and constantly cycles in new fluid as perspiration drips out of skin.

For data processing, the array plugs into a flexible printed circuit board powered by a small 3.7V lithium-ion polymer battery. The board, about the size of a business card, except thinner, contains a microprocessor and a Bluetooth transceiver that communicates with a custom app on a mobile phone. The board processes and calibrates data before transmitting it to the app. This is particularly important since the glucose and lactate sensors are enzyme-based, Javey said.



The sensors' enzymes chop off hydrogens from each of the sugars as they flow by. The amount of enzymatic chopping acts as a proxy for the sugar levels. But these enzymes are temperature-sensitive; they slow or speed sugar-chopping depending on their climate. And the temperature is bound to change when the enzyme sensors are strapped to a person working up a sweat. The microprocessor solves the problem by calibrating the sugar sensor data based on information from the temperature sensor.

To test the device, researchers attached the sensors to head and wrist bands and gave them out to 26 healthy adults as they did workouts of various intensities and lengths of time, indoors and outdoors. Compared with sweat data measured by standard lab tests, the researchers found the wearable's data accurate and potentially helpful for health monitoring.



"It's a clear demonstration of a technological advance," device scientist Jason Heikenfeld, from the University of Cincinnati, who was not involved with the study, told Ars.

Heikenfeld, who also works on sweat-sensing devices as a co-founder and chief science officer for Eccrine Systems, Inc., says that the fact that it's coming out of an academic lab is particularly nice—all the data on the device will be peer-reviewed and published, he pointed out. For consumers of future commercial products, that available data could answer a lot of questions about how well the devices work.

But, there's a lot of data that still needs to be collected before the device proves useful for monitoring health and diseases, both Heikenfeld and Javey said. Large population studies are in order, Javey noted. And for disease diagnostics, researchers will have to conduct clinical trials and win regulatory approval. Javey said the team is getting started on bigger studies now as well as exploring other types of sensors to plug into their wearable.

This next phase in the development will likely be more slow-going but also more interesting. "The cool thing about a device like this is that once you start looking at multiple analytes, you can start to discover trends from all the data you get that you otherwise might not have been able to predict," Heikenfeld said. And, because getting that data is just a matter of having people wear a sensor on their wrist or headband instead of, say, having blood drawn, collecting it may be no sweat.