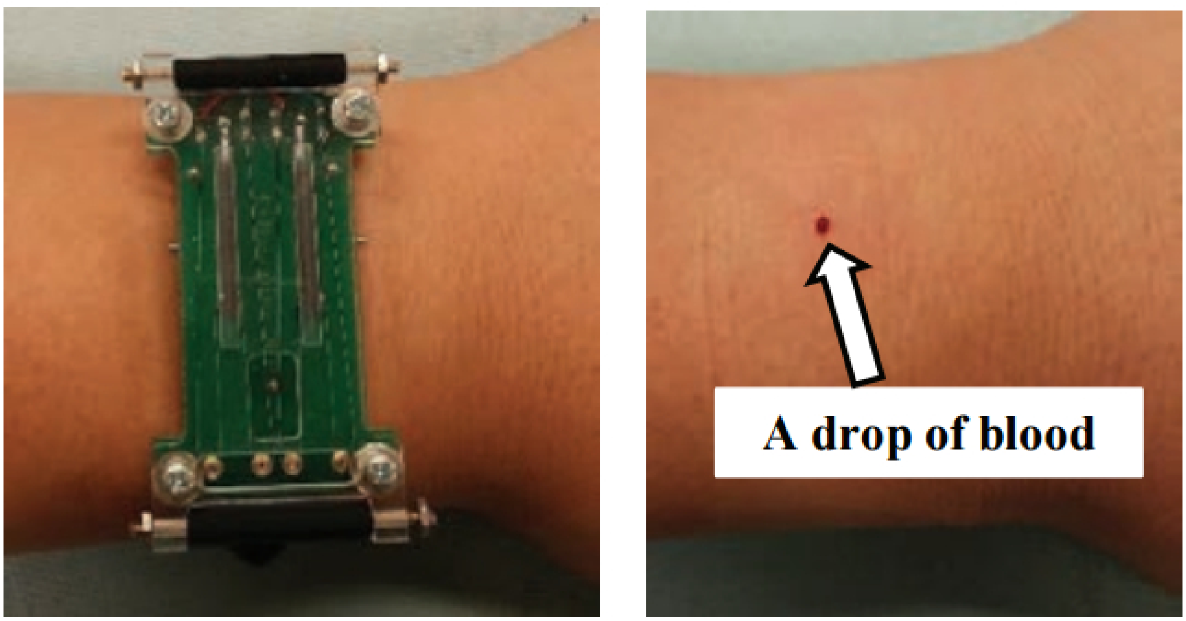
Wristband device emulates mosquito to take blood samples

June 23 2017, by Bob Yirka



Credit: *IEEE Transactions on Biomedical Circuits and Systems* (2017). DOI: 10.1109/TBCAS.2017.2669440

(Tech Xplore)—A team of researchers at the University of Calgary has developed a device that can be worn on the wrist that periodically collects blood samples for testing with glucose strips. In their paper published in *IEEE Transactions on Biomedical Circuits and Systems*, the group describes the development of their device, where it stands now, and future applications.

To test their glucose levels at home, diabetics poke their finger with a small lance and then daub the blood with a glucose strip fed into a glucose reading machine. The process is not typically very painful, but people with diabetes would prefer to not have to do it, especially those who have to do it multiple times a day. For that reason, researchers have been working on devices that extract blood and test it automatically without pain. The team in Canada has been working on such a device since 2007. It has gone through several incarnations, but the basic unit remains the same. It is worn like a wristwatch, and can be programmed to push a tiny needle into the skin at desired times to test the blood using custom test strips, the same way as is done with conventional glucose testers.

The team reports that their technology for piercing the skin and finding a capillary is based on the anatomy used by mosquitoes to extract blood. The resulting device can draw blood 100 percent of the time. They also report that the device has shrunk down from approximately the size of a deck of playing cards to that of a small wristwatch.

The team recently demonstrated their device at an IEEE meeting, noting that the earlier piezoelectric motor previously used to drive the needle into the skin had been replaced by a shape memory alloy-based actuator. The composite metal contracts when heat is applied, and reforms automatically. Besides reducing the size of the device, the actuator also offers more force, which makes the pin prick less noticeable to the person using it.

The current configuration consists of a top part that holds the batteries, LED, actuator and other electronics and a bottom part which holds a needle encased cartridge and test strips. The team is looking at ways to get around having to use custom test strips because of the added expense involved and required approval from the FDA.

More information: Gang Wang et al. Wearable Microsystem for Minimally Invasive, Pseudo-Continuous Blood Glucose Monitoring: The e-Mosquito, *IEEE Transactions on Biomedical Circuits and Systems* (2017). DOI: 10.1109/TBCAS.2017.2669440

Abstract
This paper presents a wearable microsystem for minimally invasive, autonomous, and pseudo-continuous blood glucose monitoring, addressing a growing demand for replacing tedious fingerpricking tests for diabetic patients. Unlike prevalent solutions which estimate blood glucose levels from interstitial fluids or tears, our design extracts a whole blood sample from a small lanced skin wound using a novel shape memory alloy (SMA)-based microactuator and directly measures the blood glucose level from the sample. In vitro characterization determined that the SMA microactuator produced penetration force of 225 gf, penetration depth of 3.55 mm, and consumed approximately 5.56 mW·h for triggering. The microactuation mechanism was also evaluated by extracting blood samples from the wrist of four human volunteers. A total of 19 out of 23 actuations successfully reached capillary vessels below the wrists producing blood droplets on the surface of the skin. The integrated potentiostat-based glucose sensing circuit of our e-Mosquito device also showed a good linear correlation (R2 = 0.9733) with measurements using standard blood glucose monitoring technology. These proof-of-concept studies demonstrate the feasibility of the e-Mosquito microsystem for autonomous intermittent blood glucose monitoring.