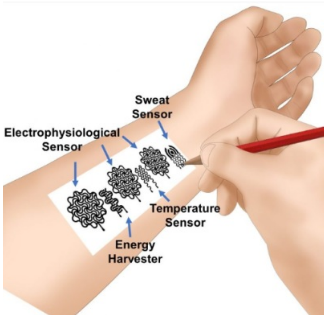
mHealth with Pencil and Paper



Fabrication of bioelectronic devices of the future may not require any complex and expensive materials but only paper and pencil. A group of engineers from the University of Missouri explored the combination of these routinely available materials and found many possible applications in personal health monitoring.

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The study (Xu et al. 2020) focussed on pencils – which usually consist of lead including various levels of graphite, clay and wax – containing over 90% of graphite. The researchers found that drawing/writing with such pencils creates a high amount of energy from friction between pencil and paper. Thus, pencil-drawn graphite patterns serve as conductive traces and sensing electrodes, and paper work as a supporting structure. For on-skin bioelectronic devices, the best combination was of pencils with 93% graphite and commercial office copy paper. Fixing the paper on skin is possible with a biocompatible spray-on adhesive.

The study covered a variety of on-skin electronic devices, such as biophysical sensors, thermal stimulators, or transdermal drug-delivery systems, among others. According to the researchers, a range of signals from human bodies can be monitored in real time, such as skin temperatures, electrocardiograms, electromyograms, heart and respiratory rates, as well as sweat pH, uric acid and glucose. It is noted that the quality of recorded signals is comparable to that measured with conventional methods. In addition, the power for the devices is independently provided by humidity energy harvesters (eg, one single-unit device of 0.87 sq. cm can generate from ambient humidity a sufficient voltage for over two hours).

The pencil-paper devices look promising as a simpler, cheaper and 'greener' alternative to existing commercial on-skin biomedical devices, which as a rule involve conventional inorganic materials, novel organic materials, or emerging nanomaterials and thus imply high material and fabrications costs as well as complex manufacturing processes and limited disposability.

The potential areas of application of such enabled devices is numerous including low-resource settings and home-based care delivery.

Source and image credit: University of Missouri

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