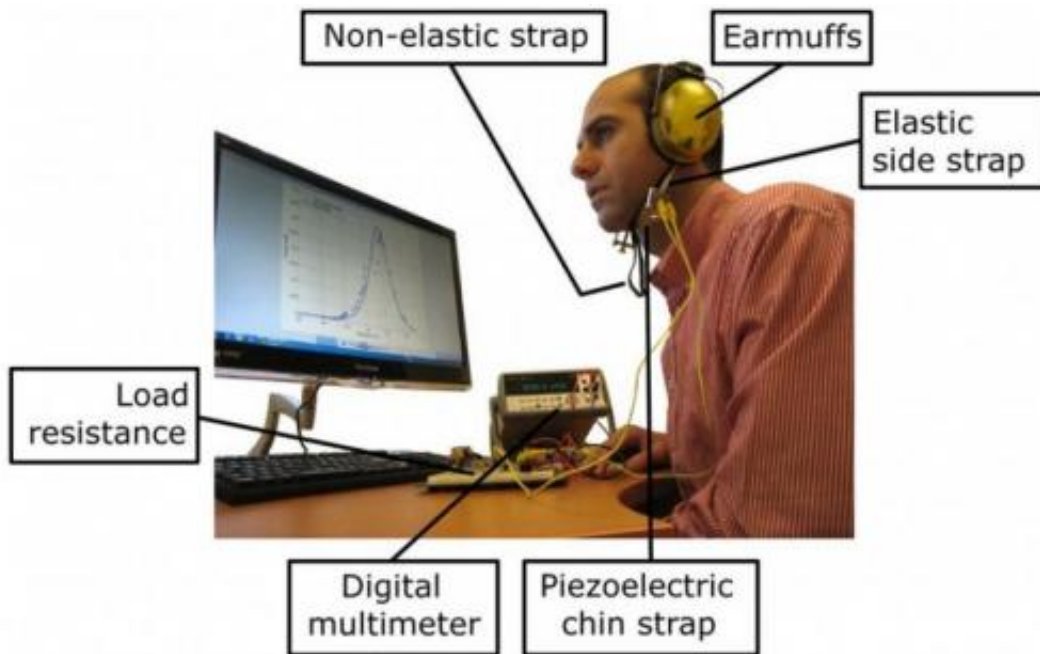


# Piezoelectric chin device harvests jaw movements for energy

September 22 2014, by Nancy Owano



Experimental setup. Credit: *Smart Mater. Struct.* 23 105020

Two researchers share the wish for more autonomy for mobile technologies, greater convenience for consumers contemplating electronic wearables, and better solutions for avoiding the environmental effects of cast-off batteries. A quest for human-powered electronics may be worth contemplating; in this context their piezoelectric chin-strap to harvest energy from chewing is drawing interest. Kinetic energy (limb motion), strain energy (muscle force), and thermal energy (body heat)

are three forms of energy that can be harvested from the human body, said the two in their report, "Flexible piezoelectric energy harvesting from jaw movements," which appears in *Smart Materials and Structures*. Their paper details the energy conversions and transformations that occur while the device is in operation.

"The jaw movement that normally occurs when chewing, eating and speaking is the most promising muscle [activity](#) from which [energy](#) could be harvested in the region of the head. For instance, one can obtain approximately 580 J only from daily chewing, which is equivalent to an average power of approximately 7 mW."

The chin strap is the result of research by Aidin Delnavaz and Jérémie Voix from the Mechanical Engineering department at the École de technologie supérieure (ÉTS) in Montreal. They used a technology called piezoelectric fiber composites (PFC). Engadget said, "The secret sauce here are piezoelectric fibers, [strands](#) of material that basically convert physical motion into electricity. Those fibers have been fashioned into a chin strap and are lashed to either sides of a pair of earmuffs, and as your mouth moves, the fibers stretch and generate power in the process." Gizmodo said, "The PFC can glean energy from the mechanical [activity](#) of the jaw, and it works as a sensor and as an energy converter."

The device involves a pair of earmuffs and piezoelectric chin strap. "The [energy harvesting](#) device consists of a flexible piezoelectric element made of PFC that fits below the chin and is attached to a head-mounted device by two elastic rubber straps," the researchers wrote. "The head-mounted device is a pair of earmuffs in our case."

Motherboard said, "Chewing causes the strap to stretch, which builds up electric charge that's then carried away by integrated electrodes." In tests, subjects were asked to chew gum. The energy output of the device

was recorded.

"In the optimum set-up of the current device, the researchers were able to [harvest](#) about 10 microwatts ( $\mu\text{W}$ ), a tiny fraction of the seven milliwatts possible in a completely ideal chewing situation, where all of the [mechanical energy](#) is converted to electricity. At the very most, they were able to squeeze out 18  $\mu\text{W}$ ," said Motherboard.

Delnavaz and Voix said that the piezoelectric strap concept can apply to all types of head-mounted devices to power small-scale electronic devices, such as hearing aids, electronic hearing protectors and communication earpieces.

The two authors work on auditory technology such as powered ear-muffs and cochlear implants, said the BBC. In the course of their work, they realized that "when you're moving your jaw, the chin is really [moving](#) the furthest," Voix said in the BBC News report. "And if you happen to be wearing some safety gear... then obviously the chin strap could be actually harvesting a lot of energy." At the same time, he emphasized that their work was a proof of concept and that the power was at the moment limited.

**More information:** 'Flexible piezoelectric energy harvesting from jaw movements' Delnavaz A and Voix J 2014 *Smart Mater. Struct.* 23 105020: [iopscience.iop.org/0964-1726/23/10/105020](http://iopscience.iop.org/0964-1726/23/10/105020)

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