Embedded recording - No current, no space, no budget

You can do quite a lot with a coin cell battery. Tune a couple of hundred guitars, stabilize a rickety table or keep your watch alive for ages. But what if you would like to record sound clips? And have them sent to your phone?

If you could get a recorder to work on a really low current, it could work. If you got down below, say, 6 mA, it would actually record for 35 hours.

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Six milliamps is not that much. Or, it is 37 thousand billions of electrons running through your system every second, but that is not very exciting if you are an electron. A light bulb would require thirty times more current.

If energy consumption can be kept this low, it would be possible to add sound recording functionality to a number of different devices. You could click on your pen to record things that are hard to capture in writing, let your hearing aid save your grocery shopping list or add a sound monitor to your home safety system.

Then, is it possible? How much energy do you need to get decent sound? Can the system be made small enough to fit in almost any device? And would it work on a budget? This has been explored in a master degree project in embedded system design.

First of all, a recording system needs a microphone. Today, they can be made as little as three millimeters long and ready to solder on circuit boards, which is common in phone and computer applications. Smaller microphones tend to lose sensitivity and low frequency content, but there are ways to compensate for this and get decent sound from very small units.

The next step would be a preamplifier, extracting the weak microphone signal to the recording system. Here, the big challenge is to keep supply power down, but still prevent noise and distortion. The sound would also need to be digitized, compressed and buffered and finally sent to a phone or to a gateway.

It may be worth putting some extra processing power in an efficient compression algorithm, to save memory and transmission time. Transmission normally cuts deep in your energy budget, so it is also important to find a suitable transmission protocol and adapt the transfer power to the range needed.

Going through the parts of the system, a lot of energy can be saved by efficient design and careful testing and tuning. However, energy gain comes to the price of lower sound quality, system speed and flexibility. Size constraints may be easier to fulfill, at least as long as there is space for batteries and a good microphone position, as components today generally are both small and cheap.

Finally, what about the six milliamps? Tests showed that the average current needed may be somewhere around 5.6 mA. Low enough to record your 35 hours and still have battery left for some guitar tuning, that is.

Erntell, R. 2016: *Embedded recording: Tiny, low-power audio solutions for wireless systems.* MSc degree project, TFRT-6024. Department of Automatic Control, Lund University, Lund.

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