MONITOR

Flap over hot chips

Piezoelectric fans could play an important role in cooling future generations of laptops, mobile phones and other gizmos

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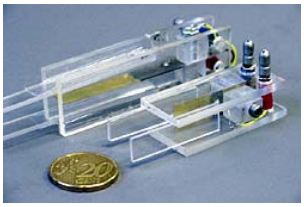
WANT to hear something really cool? How about a tiny fan that consumes a fraction of the energy of a traditional fan and removes heat twice as fast as natural convection. Made of piezoelectric material, these little ventilation wonders promise to change the way that the next generation of portable gizmos is designed.

The search for new methods of cooling has been under way ever since powerful processing chips started being crammed into hand-held devices such as PDAs (personal digital assistants), mobile phones and GPS (global positioning system) receivers. With more and more functions being added all the time, the processor chips are having to work harder, which invariably means that they get hotter. If their performance is not to suffer, ingenious ways of extracting heat have to be found.



Cool technology

The micro fans being developed at Purdue University, Indiana, use a Mylar blade attached to a ceramic with piezoelectric properties (ie, able to deform mechanically when an electric field is applied). Like the quartz crystal in a digital clock, an alternating voltage applied to the crystal in the fan causes it to expand and contract at a steady rate. As the crystal vibrates, the Mylar blade flaps back and forth like a Japanese fan, albeit a good deal faster.

Because the piezoelectric fan is a solid-state device, it has few parts to wear out. Also, having no external friction to overcome, the device does not generate any heat itself. And because there is no electric motor inside, the fan produces no electromagnetic noise to interfere with the delicate electronics of the device it is cooling.

In January, the Purdue researchers showed that the natural convection rate within a small enclosure could be doubled using a piezoelectric fan that consumed only two to three milliwatts of electricity. That compared with 300 milliwatts to do the same job using a conventional fan. In experiments for a laptop manufacturer, the team was able to lower the enclosure's interior temperature by 8°C. The piezoelectric fans were able to suck heat out of nooks and crannies that other fans left untouched.

The idea is not itself new. Piezoelectric fans were first developed in the 1970s, but finished up largely as novelty items. One firm that persevered is Piezo Systems of Cambridge, Massachusetts, but its piezoelectric fans are larger and more power-hungry than the ones the Purdue team is developing. Previous attempts to make much smaller fans failed largely because they were too noisy. It has taken some serious flow simulation studies to make them quiet and efficient enough for practical applications. Support for the work at Purdue has come from an industrial consortium that includes such companies as Apple, General Electric and Nokia.

At present, mobile phones do not have a fan inside them because such devices make too much noise, electromagnetically as well as acoustically. But the next generation of feature-rich phones will be too hot to handle without some form of forced ventilation. Apart from mobile phones, Arvind Raman of Purdue's mechanical engineering department says the group is also looking at applications in personal stereo devices, portable military equipment and dashboard terminals for cars. Dr Raman has even had inquiries from groups wanting to use the miniature fans for making "microbots" that fly.

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to see developed? Such wireless sensors the size of dust particles would float, like swarms of gnats, across enemy territory, reporting back on any movement detected on the ground.

At present, the smallest fans to do the job have blades one centimetre long. Below this size, says Dr Raman, the laws of physics are a problem. For instance, the smaller the blades are, the stiffer they become; and the less floppy they are, the more noise they make. So, Dr Raman says his group is pursuing MEMS (micro-electro-mechanical systems) technology to see if they can use chip-making equipment to etch piezoelectric fans less than a micron (millionth of a metre) in size. Feel that puff of air around the ears?

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