DIGITAL ODOUR DETECTORS COULD TELL IF MILK IS OFF BEFORE YOU OPEN THE FRIDGE.

A sense of smell

COMPUTERS ARE getting more sophisticated about the kind of data they can respond to. With standard input devices they can see, hear, feel and even decipher handwriting. Soon they'll be able to smell us too. Electronic noses – or 'e-noses', as they're now inevitably being called – have been commercially available since the mid-1990s, but the equipment is large and only suited to a lab environment. Now there's the prospect of handheld devices, capable of accurately recognising a huge range of odours.

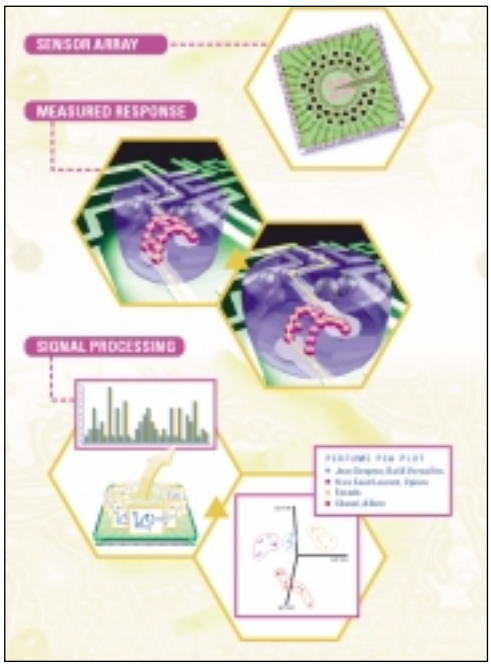
Of all our senses, smell is the least well-understood. The sensation begins when volatile chemical compounds enter the nose and hit the olfactory regions in the nasal cavities. These sensitive regions are covered with a thin layer of mucus, which helps transport the incoming chemicals to the smell receptors. There are an estimated 50 million of these cells, packed into a region about the size of a postage stamp.

The interactions of the incoming molecules with each cell cause an electrical response. This much is known experimentally, but exactly how the interactions occur remains the subject of much debate. The leading theory holds that the most important factor is the shape of the incoming molecules, and that there are seven so-called 'primary' odours, each of which is recognised separately. Another theory maintains that it's the way the molecules vibrate that is detected.

However it works, signals then feed up from groups of cells into other cells which combine the responses, and feed them higher up the nervous system. Eventually the signals reach the brain, splitting into two pathways. One enters the limbic system, the ancient part of the brain which controls motivation and emotion. The other connects to the frontal cortex, which processes the smell sensation so we can consciously recognise it. (For a very full description of the current theories see www.leffingwell.com/olfaction.htm).

Artificial noses follow similar principles, comprising a sensor device, and some kind of pattern recognition to decode the output of the sensor. There are a number of technologies in use: the sensor developed by the San Diego company Illumina (www.illumina.com), for example, uses an array of latex beads which fluoresce according to the constituents of the chemical vapour they detect. Aromascan (www.aromascan.com), a UK company based in Crewe, sells smell recognisers which use sensors made from conducting organic polymers, whose conductivity changes with odour.

One newcomer to the field is Cyrano Sciences, a startup in Pasadena, California (www.cyranosciences.com). Cyrano's prototype electronic nose, expected to be commercially available early this year, uses a technology that was first developed at the California Institute of Technology (www.caltech.edu). The system uses an array of sensors, each of which has electrically conductive particles embedded in a polymer film. The film swells when exposed to different vapours, causing the resistance of the particles to vary across the array. The signals can be read as a digital signature of the vapour, which can be identified by pattern matching against a known database of odours. This cordless device is about the same size as a mobile phone, and announces what it has detected on a small LCD display.



Cyrano Sciences uses sensors to create a digital signature, which can be checked against a known list of smells to find a match

Cyrano also promises to produce a 'nose-chip', which has olfactory sensors and recognition hardware, mounted on a conventional silicon chip, which it claims will sell in bulk for as little as £12.50.

The availability of such technology will no doubt pave the way for the inclusion of the e-nose in domestic appliances. Imagine a refrigerator that smells the items stored inside it, and tells you if they're past their sell-by date (or should that be smell-by date?). With any luck your microwave might even switch off when it smells the charring before you do.

Electronic noses might seem a bit far-fetched, but I suspect this is not a technology to be sniffed at.

TOBY HOWARD