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Smelling illness

Figure 1 Siemens' smell sensor for mobile phones

The human sense of flavour is predominantly a combination of two different senses, namely those of olfaction (or smell) and gustation (or taste). Unravelling the complex biological mechanisms that determine our sense of smell has been a challenge for decades and is only now slowly becoming more apparent with the identification of hundreds of olfactory binding proteins expressed from the human genome. Indeed, this year's Nobel Prize for Medicine has been awarded to Richard Axel and Linda Buck for their work, which has led to our understanding of the nature of odorant receptors and the organisation of the olfaction system.

During the past 20 years Warwick University has been a pioneer in the world of artificial or machine olfaction, with the development of an electronic instrument that is commonly referred to as an 'electronic nose' – an array of non-specific electronic sensors coupled to a pattern recognition system.

Today, electronic noses are commercially available from about 30 or so small companies based mainly in Europe and the USA. Until now, they have been predominately used to assure the quality of products such as foods and drinks. Recently, however, the School of Engineering at Warwick has teamed up with the Department of Biological Sciences to investigate the use of electronic noses to identify harmful bacteria or pathogens, such as *E. coli* and *S. aureus* (including the methycillin-resistant strain). The work was initially based in the laboratory with the 'sniffing' of bacteria grown in small Petri dishes, but it has since moved to the 'point-of-care', and the direct sniffing of swabs taken from Ears, Nose and Throat patients at local hospitals now takes place (see Figure 2).

This development should come as no surprise since doctors from ancient China commonly used their sense of smell to identify illnesses in patients. In the modern world, it is an attractive thought that the development of small, handheld electronic noses could some day help doctors identify an illness in a few seconds and prescribe the correct antibiotic (or antifungal) treatments. This may seem a fanciful idea, but Siemens has already launched a miniature sensor module for identifying smells that plugs into a mobile phone or PDA (personal digital assistant), so perhaps the future is closer than we think (see Figure 1). ■

Further reading

Gardner, JW and Bartlett, PN (1999) *Electronic Noses*, Oxford University Press, Oxford.

Pearce, TC, Schiffman, SS, Nagle, HT and Gardner, JW (2003) *Handbook of Machine Olfaction*, Wiley-VCH, Dordrecht, p592.

Dutta, R, Gardner, JW and Hines, EL (2004) 'Electronic noses diagnose illness', *MRS Bulletin*, October.

The development of electronic noses for biomedical applications is being led by Professor Julian Gardner and Dr Evor Hines from the School of Engineering, and Professor Chris Dowson from the Department of Biological Studies, Warwick University.

Julian Gardner is Professor of Electronic Engineering at Warwick University and leads the Sensors Research Laboratory (www.eng.warwick.ac.uk/SRL). He has published over 300 scientific papers and is an author on eight books – four of which relate to electronic noses.

Evor Hines is a Senior Lecturer in Electronic Engineering at Warwick University and leads the Intelligent Systems Laboratory and the application of neural networks and fuzzy algorithms to e-nose data.

Chris Dowson is Professor of Microbiology, past Lister Institute Centenary Research Fellow and a Medici Fellow. The Infectious Disease Research group he leads studies bacterial population diversity as a platform from which to develop novel diagnostic tools, vaccines and antibiotics.

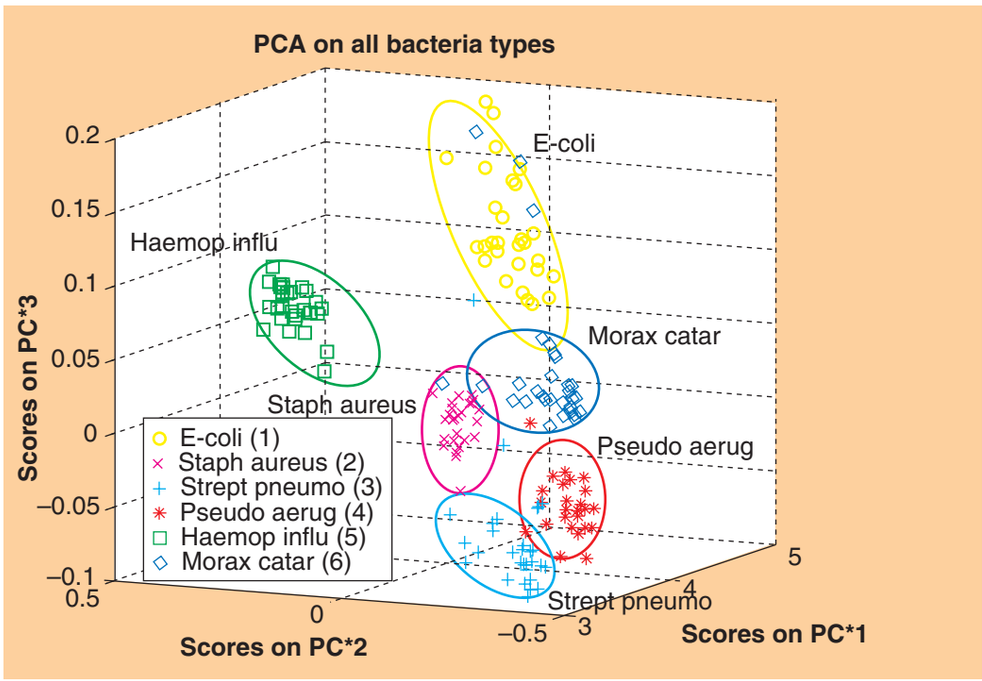

Figure 2 Electronic nose discriminates different pathogens from their chemical headspace. 32 dimensional sensor space is reduced to only three dimensionals by means of a simple principal components (PC) analysis.