Dermatology for 'droids

Researchers manufacture electronic skin for the robots of the future

Robot brains are getting smarter, and are likely to continue doing so for some time to come. While it would take several hundred of today's Pentium chips to supply as many transistors as the human brain has nerve cells, in 15 years it should take only one or two of the Pentium's successors to do the job. But the brain, while certainly the human body's most intricate and complex organ, is not its largest. That honour belongs to the skin—all two square metres and ten or more kilogrammes of it. The skin not only protects the body, the senses in it also tell the brain a lot about what is going on in the outside world. So, as man seeks to create a robot in his own image, he will need to find something for the outside to cover the Intel inside.

This week, a group of researchers led by Takao Someya of the University of Tokyo announced in the Proceedings of the National Academy of Sciences that they have taken a step towards providing such a covering. The team has fabricated flexible webs of plastic that include temperature and pressure sensors and are suitable for use as "E-skin" for robots.

The key to the team's technique is the use of transistors made from organic semiconductors. Unlike traditional semiconductors, which are crystals of elements such as silicon and germanium, organic semiconductors are more complex versions of the chemicals from which plastics are made. While organic semiconductors are not as good as their inorganic cousins for high performance computing, they can be processed at lower temperatures, which means that they can be deposited on to plastic bases that would melt if traditional semiconductors were used.

Dr Someya's E-skin consists of two layers laminated together. In one, sensitive to pressure, each transistor is connected to a conductive rubber pad whose electrical resistance changes when it is squeezed. In the other, sensitive to temperature, the transistors are connected to diodes made from two different organic semiconductors. As the temperature changes, so does the voltage measured across the diode.

To prove that E-skin is suitable for something like a robotic finger pad, the team stretched it over the top half of an egg. In addition, they pressed a small copper block that was kept at a temperature of 50°C against it. They were able to obtain simultaneous images of both the pressure and the temperature distribution "felt" by the skin.

With further technological advances, electronic skin like this could give robots more than just the human range of senses. The researchers point out that sensors for such things as humidity and ultrasound (for sensing how close the robot is to another object) could be embedded in the mesh, giving robots of the future sixth or even seventh senses.

Feeling the heat

Tended to discover whether their subjects could override this emotion-induced temporary blindness by using what they rather grandiloquently called an "attentional strategy" (ie, focusing harder on the target image). This was arranged by asking the subjects to find not any rotated photo, but a rotated photo of a building, in the array of images. The fact that they had to pay attention to both content and orientation meant they focused harder. As the researchers had expected, in this version of the experiment subjects were, on average, better at spotting the target image.

But that average concealed some interesting differences that depended on a subject's personality. The researchers knew from previous studies that the more neurotic someone is, the worse he is at controlling his attention, so they decided to see how a measure of neuroses known as the harm-avoidance scale correlated with their results. The harm-avoidance scale is a measure of a person's reaction to negative or frightening stimuli. They found that the lower a subject's score on this scale was, the more successful he was at detecting the target. This information might be useful when considering the reliability of witnesses to crimes.