Video-speed electronic-paper technology

Rob Hayes (left) and Johan Feenstra

Rob Hayes (Wolf group) and Johan Feenstra (Van de Walle group) presented a new technology for reflective, paper-like displays, which was featured on the cover of the September 25 issue of Nature. They demonstrated that electrowetting is an attractive technology for the rapid manipulation of liquids on a micrometre scale, which can be used to form the basis of a reflective display.

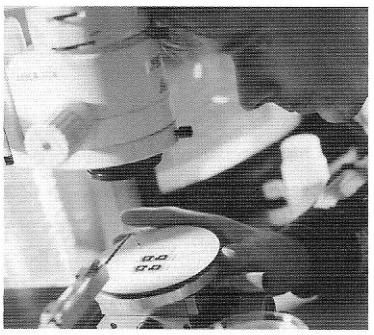
The electrowetting technology shows a video speed response, significantly faster than most other emerging technologies. Furthermore, they demonstrated a colour option that is four times as bright as conventional LCDs. The rapid response and high colour brightness may lead to electronic paper that can show video content.

Electrowetting display technology

The display principle is based on controlling the shape of a confined water/oil interface by an applied voltage. With no voltage applied, the (coloured) oil forms a flat film between the water and a hydrophobic (water-repellent), insulating coating of an electrode, resulting in a coloured pixel. When a voltage is applied between the electrode and the water, the interfacial tension between the water and the coating changes.
As a result, the stacked state is no longer stable, causing the water to move the oil aside. This results in a partly white pixel, since a reflective white surface is used under the switchable element. Because of the small size of the pixel, the user only experiences the average reflection, which means that a high-brightness, high-contrast switchable element is obtained, which forms the basis of the reflective display.

Why electrowetting

The switching between white and coloured reflection is fast enough to display video content. It is a low-power and low-voltage technology, and displays based on the effect can be made flat and thin. The reflectivity and contrast are better or equal to those of other reflective display types and are approaching those of paper. The technology offers high-brightness full-colour displays, leading to displays that are four times brighter than reflective LCDs and twice as bright as other emerging technologies. Instead of using red, green and blue segmentation, which effectively results in only one third of the display reflecting light in the desired colour, electrowetting allows making a system in which two thirds of the display area can reflect light in any desired colour. This is achieved by using pixels with two independently controllable coloured oil films plus a colour filter. The colours used are cyan, magenta and yellow, a so-called subtractive system, comparable to the principle used in everyday printing. Compared to LCDs, another factor of two in brightness is gained because no polarizers are required.



Research on display samples based on the electrowetting technology

Recently, much progress has been made within the electrowetting display project, thanks to the team including Ivo Camps, Mark Hage, Luc Schlangen and Thibault Roques-Carmes from the Nat.Lab. and Tony Franklin and Armando Valdes from Redhill. With the major contributions from the Devices, Technology & Services (DTS) department, this resulted in a very successful public demonstration of the technology at the recent International Display Research Conference in Phoenix.

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