



No snooping allowed!

The viewing angles of lcds have widened in the last few years, contributing to a substantial rise in the popularity of this display technology. Some panels allow the viewer to sit in virtually any position within an angle of 170° around the display and to still see a perfect picture without shifts in colour value or – as in the case of conventional twisted nematic (tn) displays – the picture tilting into negative. This means several users can use an lcd at the same time.

However, there are situations in which you don't want other people seeing what's on the screen or where viewers do not want to or are not supposed to see the same picture. With that in mind, Sharp has gone one step further: using recently developed switchable liquid crystal technology, the light from the background lighting can be targeted in different directions, offering a variety of potential applications that include a variable 2d/3d display.

Based on this method, Sharp has recently launched two displays with variable viewing angles. The first can show different picture information for the right hand and left hand viewing angles at the same time. This means viewers sitting on either side of the screen can see different content. And if this function is no longer required, the display can be switched back to normal view.

The second version is a display where the viewing angle can be switched from wide angle to one with a restricted side-ways visual range, enabling confidential information to be seen only by those sitting directly in front of the screen.

Sharp's research laboratory in Oxford laid the foundation for this innovation in 2001, with the development of a prototype display that could be switched from 2d to 3d. The breakthrough meant view-

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Switchable lcds allow users to shield the screen or share the view. By Sven Stegemann.

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The key feature of the variable technology is based on an optical trick: if different pictures are created for the left and right eye, the overall picture appears three dimensional. The Parallax Barrier developed by Sharp shields both eyes from each other, thus separating the pictures. This barrier is an

aperture grill consisting of switchable liquid crystals, situated between the tft panel and the backlight. Technically, this is a second lcd whose silicon structure contains a specially developed liquid crystal and can be controlled independently of the actual tft.

By means of electrical signals, the strings of molecules within the switchable liquid crystals can be arranged so they can direct the light from the tft backlight towards the left or right eye. On the display itself, the picture appears in different bands for the left and right eye in each case. For technical reasons, this means luminosity and definition are reduced by around 50% as half of the pixels are needed to display the partial picture for the

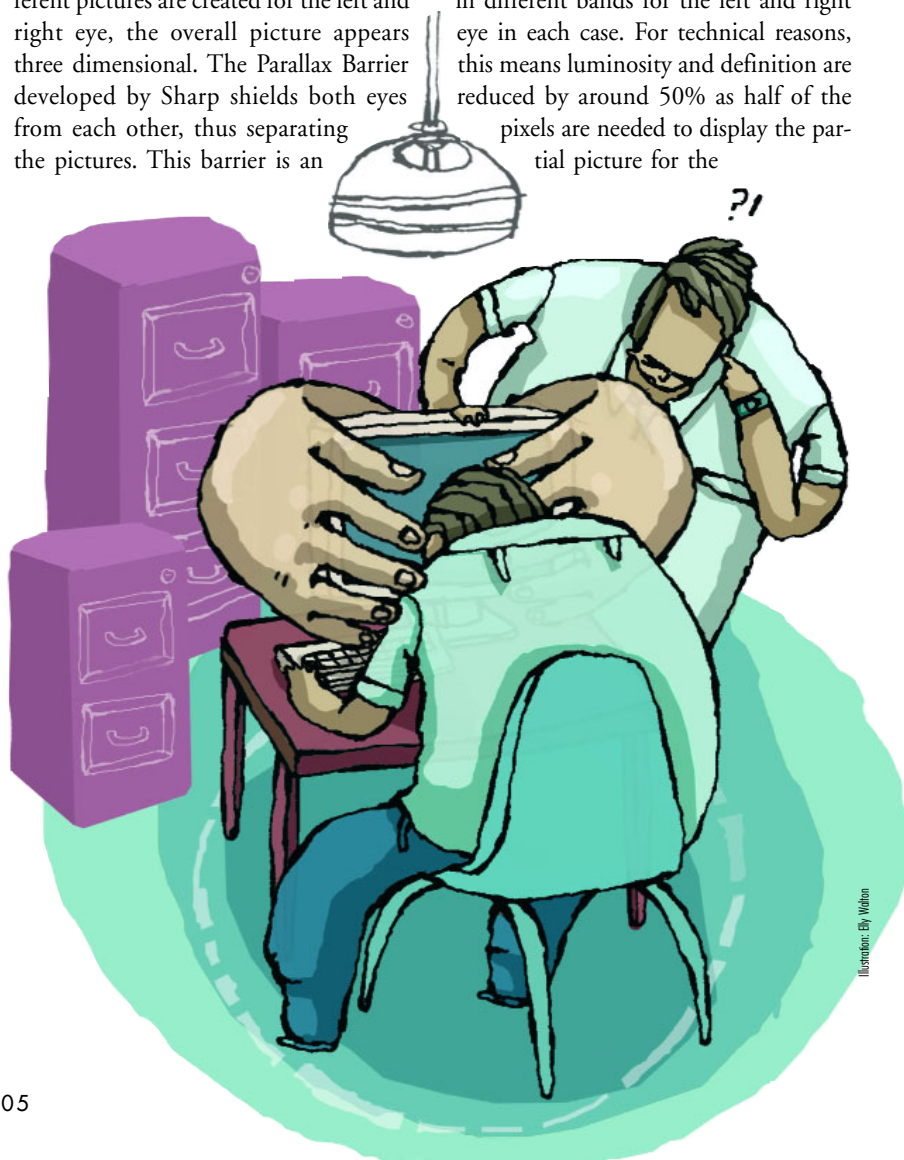


Illustration: By Watson



"In areas such as medicine, science, industry and computer games ... a future without 3d technology is unimaginable."

Sven Stegemann, **Sharp**

right eye and half are needed to display the partial picture for the left eye. Compared with standard high luminosity and high definition displays currently available however, the panel does give a high quality picture, even in 2d mode.

In idle mode, the so called 'switching liquid crystal' level is completely transparent, so a 2d picture appears. The qual-

ity of its definition, colour reproduction and luminosity is equivalent to that of a conventional display.

Each to his own

The technique for the simultaneous display of different picture information is based on a further development of the parallax barriers. Here, too, the switchable liquid crystals are superimposed on the tft lcd as an additional liquid crystal layer. If the two picture mode is activated, the switchable liquid crystals arrange themselves into an aperture grill. The light from the background lighting is now directed to the left or the right so that, at different viewing angles, different pictures are displayed on the same screen. Here, too, the two pictures each appear on the display as different bands. A mere 10° deviation from the normal display area view is sufficient to see one of the two pictures.

The concept of the display with switchable viewing angle is also based on the integration of a layer of switchable liquid crystals in a conventional tft lcd. The double refraction of the liquid crystal molecules enables the light path from the background lighting to be directed specifically, with the tension adjusted by pressing a button. The strings of molecules are arranged so that no light can emerge to the left or to the right and the wide angle display is reduced to a narrow viewing angle.

Switchable liquid crystal technology allows dual functions that offer added value for a range of applications. What is important here is the possibility of switching from one mode to the other at any


time, without sacrificing picture quality. That's because for the users, regardless of whether they are end consumers or professional users, the unrestricted viewing angle or the two picture display is mainly of interest as an additional function. This has already been demonstrated by the success of the 2d/3d display. Sharp's SH251 mobile phones are fitted with 2d/3d displays and notebooks and monitors are now available with the same technology.

In areas such as medicine, science, industry and computer games, for example, a future without 3d technology is now unimaginable.

With increasing use of mobile and networking solutions, demand is growing for portable devices which can display confidential information such as



e-mails, without unauthorised persons being able to read the information at the same time. Other potential applications for lcds with switchable viewing angles are cash machine terminals. When users enter their PIN, the machine uses narrow angle viewing mode. If the machine is not being used, the display switches to wide angle to display advertising.

The lcd that can display two different programmes simultaneously goes beyond resolving domestic squabbles over the remote control! Applications include monitors on which buyers can view a particular product and vendors can view additional product data and gaming devices. 

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Making a 3d lcd

Before developing its current 3d display solution, Sharp explored several possibilities, including one comprising two tfts and a semireflective mirror, plus an eye tracking device that allowed the computer to generate the optimum quality 3d picture. Rejected as too complex, the research team then experimented with the concept of the parallax barrier, gluing a piece of striped glass

on top of a tft. Whilst further development produced a good quality 3d picture, the problem was how to position the user. One answer was using an indicator at the bottom of the screen which could show when the user was in the optimum position.

Market research showed 3d was commercially attractive, but only as an option on a conventional display. Hence, Sharp's progress towards a switchable technique that doesn't compromise picture quality when the 3d function is switched off.