

## ELECTRONIC PAPER

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Electronic paper, e-paper or electronic ink display is a display technology designed to mimic the appearance of ordinary ink on paper. Unlike a conventional flat panel display, which uses a backlight to illuminate its pixels, electronic paper reflects light like ordinary paper and is capable of holding text and images indefinitely without drawing electricity, while allowing the image to be changed later.

To build e-paper, several different technologies exist, some using plastic substrate and electronics so that the display is flexible. Anecdotal evidence suggests that e-paper is more comfortable to read than conventional displays. This is due to the stable image, which does not need to be refreshed constantly, the wider viewing angle, and the fact that it reflects ambient light rather than emitting its own light. An e-paper display can be read in direct sunlight without the image appearing to fade. The contrast ratio in available displays as of 2008 might be described as similar to that of newspaper, though newly-developed implementations are slightly better. There is ongoing competition among manufacturers to provide full-color capability.

Applications include electronic pricing labels in retail shops, and general signage, time tables at bus stations, electronic billboards, the mobile phone Motorola FONE F3, and e-Readers capable of displaying digital versions of books and e-paper magazines. Electronic paper should not be confused with digital paper, which is a pad to create handwritten digital documents with a digital pen.

Electronic paper was first developed in the 1970s by Nick Sheridan at Xerox's Palo Alto Research Center. The first electronic paper, called Gyricon, consisted of polyethylene spheres between 75 and 106 micrometres across. Each sphere is a janus particle composed of negatively charged black plastic on one side and positively charged white plastic on the other (each bead is thus a dipole). The spheres are embedded in a transparent silicone sheet, with each sphere suspended in a bubble of oil so that they can rotate freely. The polarity of the voltage applied to each pair of electrodes then determines whether the white or black side is face-up, thus giving the pixel a white or black appearance. At the FPD 2008 exhibition, Japanese company Soken has demonstrated a wall with electronic wall-paper using this technology.



Electro fluidic displays are a variation of an electro wetting display. Electro fluidic displays place an aqueous pigment dispersion inside a tiny reservoir. The reservoir comprises <5-10% of the viewable pixel area and therefore the pigment is substantially hidden from view. Voltage is used to electromechanically pull the pigment out of the reservoir and spread it as a film directly behind the viewing substrate. As a result, the display takes on color and brightness similar to that of conventional pigments printed on paper. When voltage is removed liquid surface tension causes the pigment dispersion to rapidly recoil into the reservoir. As reported in the May 2009 Issue of Nature Photonics, the technology can potentially provide >85% white state reflectance for electronic paper.

The core technology was invented at the Novel Devices Laboratory at the University of Cincinnati. The technology is currently being commercialized by Gamma Dynamics.

In January 2007, the Dutch specialist in e-Paper edupaper.nl started a pilot project in a secondary school in Maastricht, using e-Paper as digital schoolbooks to reduce costs and students' daily burden of books.

In December 2005 Seiko released their Spectrum SVRD001 wristwatch, which has a flexible electrophoretic display.

Motorola's low-cost mobile phone, the Motorola F3, also uses an alphanumeric black/white electrophoretic display.

In September 2006 Sony released the PRS-500 Sony Reader e-book reader. On October 2, 2007, Sony announced the PRS-505, an updated version of the Reader. In November 2008, Sony released the PRS-700BC which incorporated a backlight and a touch screen.

Some devices, like USB flash drives, have used electronic paper to display status information, such as available storage space.

In February 2006, the Flemish daily De Tijd distributed an electronic version of the paper to select subscribers in a limited marketing study, using a pre-release version of the iRex iLiad. This was the first recorded application of electronic ink to newspaper publishing.

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