Inkjet Technology

Printing of documents and graphics has become as easy as eating a piece of cake with the invention of inkjet printers. Recent technology has helped to discard the minor faults in these printers, which has attracted more consumers to buy them instead of any other type of desktop printers.

Inkjet printing, like laser and thermal printing, is a non-impact method. Ink is emitted from nozzles as they pass over a variety of possible media, and the operation of an inkjet printer is easy to visualize: liquid ink in various colours being squirted at the paper to build up an image. A print head scans the page in horizontal strips, using a motor assembly to move it from left to right and back, as another motor assembly rolls the paper in vertical steps. A strip of the image is printed, the paper moves on, ready for the next strip. To speed things up, the print head doesn't print just a single row of pixels in each pass, but a vertical row of pixels at a time.

There are several types of inkjet technology but the most common is "drop on demand" (DOD). This works by squirting small droplets of ink onto paper, through tiny nozzles: like turning a hosepipe on and off 5,000 times a second. The amount of ink propelled onto the page is determined by the driver software that dictates which nozzles shoot droplets, and when.

The nozzles used in inkjet printers are hair fine and on early models they became easily clogged. On modern inkjet printers this is rarely a problem, but changing cartridges can still be messy on some machines. Another problem with inkjet technology is the tendency of the ink to smudge immediately after printing, but this, too, has improved drastically during the past few years with the development of new ink compositions.

Different companies have come up proprietary techniques. HP and Canon prefer the thermal technology, whereby heat is used to fire ink onto the paper, whereas Epson uses a piezo-crystal at the back of the ink reservoir. This crystal flexes when an electric current flows through it. So, whenever a dot is required, a current is applied to the piezo element, the element flexes and in so doing forces a drop of ink out of the nozzle. Since the piezo process can deliver small and perfectly formed dots with high accuracy, Epson is able to offer an enhanced resolution of 1440 by 720dpi - although this is achieved by the print-head making two passes, with a reduction in print speed.

Creating colour

Creating colour accurately on paper has been one of the major areas of research in colour printing. Like monitors, printers closely position different amounts of key primary colours, which, from a distance, merge to form any colour; this process is known as dithering. Monitors and printers do this slightly differently. Monitors mix the light from phosphors made of the primary additive colours: red, green and blue (RGB), while printers use inks made of the primary subtractive colours: cyan, magenta and yellow

(CMY). The coloured inks, reflecting the desired colour, absorb white light. In each case, the basic primary colours are dithered to form the entire spectrum. The colour generated on the printed page is dependent on the colour system used and the particular printer model; not by the colours shown on the monitor.

Print quality

The two main determinants of colour print quality are resolution (measured in dpi) and the number of levels that can be printed per dot. Generally speaking, the higher the resolution and the more level per dot, the better the overall print quality. Half toning algorithms divide a printer's native dot resolution into a grid of halftone cells and then turn on varying numbers of dots within these cells in order to mimic a variable dot size. By carefully combining cells containing different proportions of CMYK dots, a half toning printer can "fool" the human eye into seeing a palette of millions of colours rather than just a few.

To the basic printing ink colours, a fourth ink, black, is added to create purer, deeper shadows and a wider range of shades. By using varying amounts of these, a large number of different colours can be produced. Here the level of ink is measured from 0% to 100%, with orange, for example being represented by 0% cyan, 50% magenta, 100% yellow and 0% black.

This was an overview of the basic principle of working of inkjet printers. More and more companies are working to develop better printers with high printing speed and better quality printing. So the next time you print a document, just think about the amount of technology and research that has gone in to produce an exact copy of what you see on screen.