Optical illusions

Flatbeds, handhelds, document... They're all types of scanner. As an extra dimension to this month's group test, Gordon Laing puts you in the picture.

First things first. Last month's *Graphics and DTP* suffered a last-minute change, with the unfortunate result of an incorrect caption for the font-smoothing examples. It also doesn't take a genius to spot that our reproduction house failed to properly convert any of the screenshot TIFFs into CMYK, resulting in a load of black-and-white pics. Oh well, the joys of layout and reproduction.

For those interested in font smoothing, the caption should have read as follows.

"From the top working down: 8 point TrueType Times, 8 point Type-1 Times, 18 point TrueType Times, and 18 point Type-1 Times, all enlarged to indicate the differences. As explained last month, Windows 95 Plus Pack offers on-screen anti-aliasing smoothing of TrueType fonts, which makes the ATM rendered Type-1 fonts look particularly jagged."

Thanks to everybody who has written to me about the typography pieces that have appeared in these pages over the past few months. There's lots more in the pipeline. However, a complementary piece to this month's scanner group test occupies our attention here.

Scanners: the basics

Starting on page 126, we've tested and reviewed 18 devices: four handhelds, six flatbeds and eight document scanners. What type of scanner should you buy? Many people head straight for the flatbeds when they might be far better off with a document scanner. Then there's the minefield of resolution and colour bit depth, where in theory bigger is better. But do you need it, and what exactly can you use it for anyway?

As with all purchasing decisions, you must first decide exactly what you want to do with the scanner, what standard of performance you are expecting from it, and how much you are prepared to spend.

It's best to start by deciding what kind of images you wish to scan. An increasingly popular scanning application is optical character recognition (OCR): the computer tries to convert a scanned page of words into an electronic text document; it is effectively reading the words. OCR, explained in greater detail within the group test, is not an infallible process. Even the most sophisticated OCR packages will make mistakes, particularly with badly-printed originals, and you will always have to proof-read the resulting document. Even so, the main body of the text will be present, making OCR a huge time-saver for those who do a lot of retyping.

OCR does not require a colour scanner, although many OCR packages can make use of greyscale information to better recognise character shapes. It's often handy to have some sort of automatic sheet feeder, letting you leave the device to scan several pages of text at once. If your original is not in sheet form, like a book or a magazine, you can photocopy the page and feed that through instead.

If OCR is going to be your primary scanning application, you should consider a document scanner. This breed of scanner is becoming the most popular thanks to their ease of use, low price and small size. Most are about the same size as a roll of kitchen paper, and feature built-in sheet-feeders which drag the pages through like a fax machine. They're cheap, too, costing between £99 and £250.

The software packages vary, but the best combinations of device and drivers fire up automatically as soon as a sheet is fed into the machine. All boast OCR and some kind of document management software. You can use a document scanner as a fax machine, but you'll need a fax modem, which will offer suitable software.

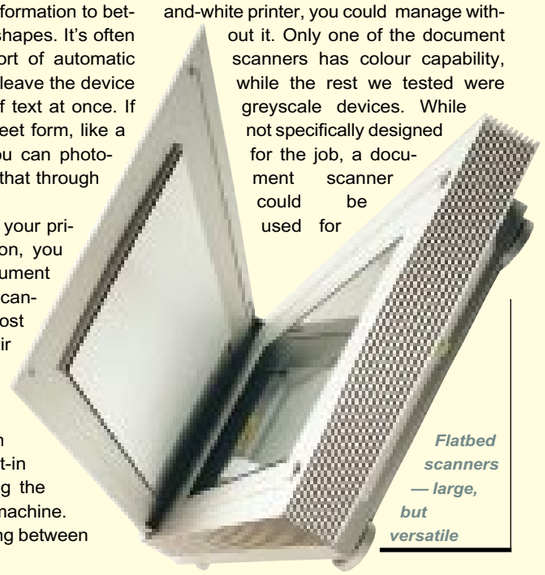
A flatbed scanner is perfectly capable of doing OCR, but if you want it to sift through a wad of sheets, you'll need to buy an additional automatic document feeder (ADF). These are expensive and not available for all models. A flatbed does have the advantage of being able to scan thick originals, such as books, magazines and even solid objects laid carefully on the glass plate.

A handheld scanner could be used for OCR, but is not recommended for any documents wider than the typical four-inch scanning width. This eliminates the vast majority of A4 documents. Handhelds often feature software which can stitch multiple scans together to make one big image, but this is not recommended for OCR.

Dealing with photographs

The other big scanning application is getting photographic images into your computer. Once scanned, a photo can be manipulated to improve the quality and remove or add desired elements. Afterwards it can be printed again, placed in a DTP document, or viewed on-screen on, say, a web site or CD-ROM title. Where the image ends up is the most important factor in choosing a suitable scanner.

In virtually all cases you'll want colour, although if you're only printing on a black-and-white printer, you could manage without it. Only one of the document scanners has colour capability, while the rest we tested were greyscale devices. While not specifically designed for the job, a document scanner could be used for digitising printed photographic images, although most only offer low resolutions which could be limiting.



Flatbed scanners — large, but versatile

Handheld scanners — limited, but small and cheap

It's easy to get carried away with flat, reflective originals, such as printed photos and sheets of paper. Three-dimensional reflective originals, such as coins and keys, can be carefully placed on the surface of a flatbed, but flatbeds have a very limited depth of field and can only cope with objects small enough to fit on the plate. If you want to digitise a larger object and optionally keep the whole thing in focus, you'll need a digital camera.

Digital camera... action!

You may not have realised, but a digital camera carries a rectangular CCD imaging device which, when connected to a computer, produces the same kind of bitmapped files a plain scanner does. You could photograph your three-dimensional object, like a person, house or landscape, using a conventional camera and then scan the print using a conventional scanner.

What if your original isn't reflective at all, but transmissive like film transparencies? Scanning film is big business, but requires the light to be picked up after it has travelled *through* the original, rather than reflected off it. Many flatbed scanners offer an optional transparency adaptor, which is little more than a new lid with a built-in light source. These cost about £500 and have one big disadvantage — they are still limited by the resolution of your CCD transport, typically between 300 and 600dpi.

300 dots per inch may be more than adequate when scanning a photo several inches across, but film originals tend to be much smaller. Take 35mm, which measures about 1in x 1.5in. Even a 600dpi scanner won't be able to offer enough resolution to reproduce a 35mm transparency, or reflective original for that matter, to much larger than double the size.

It's the dots that do it

It ultimately depends on how many dots per inch your output device requires, but as far as going into colour print is concerned, flatbed scanners with transparency adaptors are usually not good enough for 35mm film. In professional cases, they only become useful for 5in x 4in originals or higher. Exceptions include the very high-end Agfa DuoScan and Umax PowerLook 2000 flatbeds, both costing just short of £4,000 (plus VAT RRP).

You want small-format film scanned well? You'll need a dedicated film scanner, which concentrates all its dots into a tiny distance, where flatbeds in comparison lounge over eight or so inches. A film scanner may have the same number of elements on its CCD as a flatbed, but by limiting them exclusively to a very small area, their resolution could be over 2000dpi compared to the flatbed's 300.

If you only scan film, you may want to look into buying a proper film scanner; but the rest of us, who want occasional decent 35mm film scans without the investment, can turn to Kodak's Photo CD. The Photo

Font of the Month

Another display face from Fontek this month, available as a single weight for only £35 (plus VAT).

Document scanners — small, cheap and great for OCR

CD format is capable of storing up to 100 35mm images on a single recordable CD. Each image is stored in five resolutions, from a tiny thumbnail up to a whopping 18Mb file, certainly good enough for reproduction in a magazine after sharpening and colour correction. Most commercial photo labs with a two-week turnaround time charge less than a couple of pounds per image. Professional Photo CD labs can handle up to 5in x 4in film.

And so, to interpolation

Resolution plays a big part in scanning, and advertisers often try to confuse the issue by quoting the maximum interpolated resolutions of their scanners. Interpolation is the process of making up values in-between real ones to bump up the figures. It can work well for black-and-white line art originals, but is best experimented with rather than relied on. Check out our half-page in the group test where the same letter "g" was scanned at the highest claimed interpolated resolution of each flatbed, and see how some don't quite measure up. It's the horizontal optical resolution that counts, and for most CCD scanners (handheld, document or flatbed), that's between 300 and 600dpi.

It's safe to say that all of today's scanners boast optical resolutions capable of OCR work, but as identified in the earlier comments about scanning tiny originals like film, higher resolving powers can come in handy. As soon as you've discovered which scanning resolution is good enough for your output device, make a note of it. Remember that if you want to reproduce the original at twice the size in the same quality, you'll need to double the resolution. That's why 35mm film scanners may boast resolutions of several thousand dots per inch in order to produce images that can be reproduced to many times their original physical size.

Scanning for reproduction in glossy magazines requires extremely high resolutions. The image setters used to print these magazines work at about 2400dpi. Outputting to a laser printer, even at 600dpi, is clearly much more forgiving. Take your monitor, which, depending on its size and the mode you're running in, will only be working at a resolution of between 70 and 100dpi. That's why you often have to zoom out several times in order to view entire scans with your limited number of on-screen dots.

The outlook is bright

Increasingly common applications for on-screen images are internet web pages or multimedia CD-ROM titles; viewing on-screen only requires quite modest or even low resolutions. One danger to be aware of is brightness and colour matching. Let's say your scan looks great on your monitor, which could be at a bright setting. When viewed on someone else's monitor, which could be much darker, the image will not look anywhere near as good. Check out how it looks on other systems before you pat yourself on the back on your fabulous homemade web page or CD title.

Before going any further, please note that you shouldn't necessarily scan at 600dpi if you've got a 600dpi printer. Most printers are incapable of printing shades, and can only either leave a dot or no dot at all. To simulate shades, they use a technique known as half-toning where different-sized dots are grouped to represent a shade when viewed from a distance. The bigger the dots or the closer together they are, the darker the perception. Similarly, the smaller or the further apart the dots are, the lighter the perception. Just look at a newspaper photograph closely to see how a greyscale image is printed with only solid black dots of varying size.

The upshot of this is that a printer usually has to place several dots to represent one shaded dot provided by the scanner. A 600dpi printer simulating 64 grey levels needs no higher than a 75dpi scan for same-size reproduction. Higher scanning resolutions need only be used for higher resolution printers, reproducing the original larger than real size, or for scanning black-and-white line art.

Bits and bobs

The last hurdle for now is bit-depth. Earlier scanners were either colour or not. Now there are different types of colour scanners, identified by the number of bits per dot or pixel. The first CCD colour scanners were described as having 24 bits. These are the same bits as used to describe your graphics-card display.

In a digital system you must have a finite number of colours or shades. How many shades of grey should a digital system have between pure black and pure white in order for the human eye not to discern the steps? A figure convenient for computers was 256, which in binary is 8 bits or a single byte. Full colour can be made up of a combination of red, green and blue light. 8 bits per colour makes 24 bits in all for full-colour scanning. Or does it?

The best analogy is building a car to perform well at 70mph. Should its top speed be 70mph? No. We all know that in order to perform well at 70mph, your car should be capable of a much higher top speed. It's is the same with scanners which suffer from undesirable noise, particularly in the least significant bits which represent the dark, shadowy areas of an image. In reality, a 24-bit scanner may be able to supply 20 good bits.

Then there's the problem of image manipulation. Every time you make an overall colour or brightness/contrast adjustment, you lose quality. Starting with more than 24 bits will ensure that after correction and noise clean-up, you'll still have a good 24 to work with. Enter the recent 30 and 36-bit scanners, capable of picking up all those tricky shadow and highlight details that were lost on inferior models. They are more expensive, but make a difference when scanning higher-density originals such as film, and/or for reproduction on high-quality output devices.

Drumming it in

Drum scanners are very expensive devices which use photo-multiplier tubes instead of CCDs, and offer a much higher tonal dynamic range than a typical CCD scanner. The tonal dynamic range relates precisely to the scanner's density rating, which for CCD flatbeds should be indicated by the number of bits. A true 36-bit CCD device should begin to approach the tonal dynamic range offered by a drum scanner. High-end flatbeds from manufacturers like Agfa and Umax claim to offer drum-quality output. One of these two flatbeds will leave little change from £4,000, while getting a bureau to do your work for you will set you back around £20 per drum scan.

● *I hope this column has helped you choose what kind of scanner you need. All you have to do now is turn to the group test to see which models we recommend.*

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