Topic 1: Introduction
Workshop Solutions

Workshop Questions

1.1 Video Data Rates

When UK video standard images are sampled each frame consists of 768 by 586 pixels (there is actually 625 lines, but the some are user for teletext). Images are scanned at 25 Hz. Calculate the digital data rate of such a video signal.

A typical high quality graphics card in a PC will display 24 bit colour (8 bits red, green & blue), at a resolution of 1280 by 1024, with an refresh rate of 60 Hz. Calculate the data rate for this card and compare it with standard computer hardware.

Solution

Assume that the image is monochrome, then if there is 1 byte per pixel then one frame contains:

$$768 \times 586 = 440\text{kbytes}$$

TV refresh rate is 25 frame per second, so the total data rate is:

$$10.7\text{MBytes}\,\text{s}^{-1}$$

This speed can easily be reached by the modern fast computer conenctions of:

$$\begin{aligned} \text{FireWire 400} &\rightarrow 50\text{Mbytes}\,\text{s}^{-1} \\ \text{USB2} &\rightarrow 60\text{Mbytes}\,\text{s}^{-1} \\ \text{FireWire 800} &\rightarrow 100\text{Mbytes}\,\text{s}^{-1} \\ \text{Gb Ether} &\rightarrow 125\text{Mbytes}\,\text{s}^{-1} \end{aligned}$$

but cannot by the more conventional

$$\begin{aligned} \text{WiFi 802.11g} &\rightarrow 6.75\text{Mbytes}\,\text{s}^{-1} \\ \text{Bluetooth} &\rightarrow 0.375\text{Mbytes}\,\text{s}^{-1} \end{aligned}$$

Standard TV is actually 50 Hz “interlaced” so that half of the image is refreshed 50 times per second with the the “odd” and “even” lines being refreshed alternatively.

For fast PC card data in one frame is:

$$1280 \times 1024 \times 3 = 3.93\text{Mbytes}$$

so if the whole frame is refreshed at 60 Hz, then the total data rate is

$$236\text{MBytes}\,\text{s}^{-1}$$

which is well in excess of normal computer communication systems Only fibre optics will offer the giga-bit data rates required.

1.2 Film Scanner

A high quality flat bed scanner, is capable of scanning pages **or** transparancies at 100 samples/mm (2400 dpi). It samples in 24 bits (8 bits red, green, blue). Calculate the size of the image file (in MBytes) if you scanned the following at maximun resolution.

1. A 35 mm colour slide (24×36 mm image area).
2. A 6×6 cm large format colour negative. (This is the format used by studio photographers).
3. A colour postcard.
4. An A4 page.

and comment of the answers you get.

You want to send 12 large format scanned slides by courier to a magazine editor, what computer media would you choose.

Solution

At 100 samples/mm with 3 bytes per sample, this gives 30 kbytes/mm^2 of scan:

Format	Area	Size
35mm Slide	864 mm^2	25.9 Mbytes
$6 \times 6 rmcm$ Slide	3600 mm^2	108 Mbytes
Postcard (4×6")	$15,000$ mm^2	450 Mbytes
A4 Page (297×210 mm)	$62,370$ mm^2	1.9 Gbytes

Clearly this is huge amounts of data. In it is not worth scanning postcards and A4 pages at this resolution, (see later discussion on sampling theory), but it *does* make sense to sample high quality negative or slides at this rate. This means that images of $>$ 100 Mbyte routinely produced.

Want to send 12 images of 108 Mbytes each, that is about 1.3 Gbyte of data.

Your options are:

Floppy disc: (1.44 Mbytes each) You would need 900 of them!, not very useful, this is why floopy discs are *almost gone*.

Recordable CD-ROM: (680 Mbytes on each) Get 6 images on each, so you would need two. Fairly slow to write.

Recordable DVD: 4.3 Gbytes per disc, record time a bit slow, often slower than the CD-ROM option and media a bit more expensive.

USB Pen: Up to 4 GByte on single pen drive. Fast to write and very small. Good method, provided you get the back afterwards.

Aside: 5 years ago this was a major problem, but has been solved by DVD or high capacity pen drives.

1.3 Tool for Displaying Images

You will be using the `xv` image display program to view digital images. There are a range of digital images located in

```
~ wjh/dia/images
```

that you should look at. These images are all monochrome and are in binary `pgm` format. They include simple gratings, fans, the “toucan”, the famous “lena” and a range of other images.

Use `xv` to look at these images and explore the use of `xv` to resize images, write as postscript (which you can print) etc. You will be making much more use of `xv` and these images during this course.

Solution

You need to play with this yourself!