

# **Gerald's Column**

## **by Gerald Fitton**

Last month I introduced my new theme by asking you to consider what you what you might want to use your next computer for. Judging by the large number of replies which I have received, this topic is of great interest to you.

Thank you to all those who have written to me. I found your comments most interesting and greatly informative. I shall summarise those comments later in this series of articles.

### **Recapitulation**

Last month I presented a brief outline of the recent history of computers and I made the enigmatic comment: “only by studying our past shall we be able to accept our future”. I expanded on this by saying: “without a knowledge of this history we shall be at the mercy of the most recent craze, surfing!” In this series I want you to look to the future of computing and in particular how you, dear readers, see that future expanding. Please don't limit your thoughts to the various means of doing what you do now but faster and better!

Personal Computers were first used by enthusiasts who did their own programming and, typically, we ‘elite few’ wrote programs which had a strong mathematical content.

Later word processing took over from programming as the single most important reason for buying a personal computer. Yet later this was followed by desk top publishing.

Nowadays the use of the Internet has a prime position.

Rather than simply looking at the way in which computers have been used, I shall consider how some of the components of a computer have advanced over the last couple of decades and how these advances have changed the ways in which home computers are used.

### **Numbers**

The Central Processor Unit (CPU) of the earliest electronic computers had a clock speed of a few Mhz (implying, at most, a few million sums per second). In these days of GHz CPUs this might seem slow but, when compared with doing sums manually, it was lightning fast.

Those earliest machines did not have nor did they need much memory. They were used in applications for which the data input (such as my mother's date of birth) was small compared with the amount of calculation needed to return “Full of grace!”. These applications usually involved large amounts of arithmetic and, occasionally, some logical analysis as well.

### **Words**

A good typist, one better than I am, will have a typing speed of about five to ten characters per second. In our RISC OS machines each character is represented by a single (eight bit) byte using an extension of the original seven bit ASCII code. In more recent machinery, instead of character sets which are limited to 256 characters, more than one byte is used. The word “Unicode” comes into my mind! I don't want to digress too far at this point in my discussion so I shall postpone Unicode until another day—but if you believe that Unicode should be a feature of your next computer then write to me and tell me why.

If we equate one character to a single byte and err on the generous side (ten characters per second) then we can calculate an 'upper limit' for the 'data transfer rate' from written sheets of paper via a skilled typist into the memory of a computer. This calculation returns a value of approximately 36 Kb per hour. Of course, 36 Kb in one hour is unrealistic. In the real world, with breaks, checking and corrections, a data input rate of 10 Kb per hour for a skilled 'key to disc' operator is a more practical figure.

You will not need to get out your favourite spreadsheet in order to calculate just how long it would take such a skilled operator to fill an 800 Kb floppy disc. Somewhere between 20 and 100 hours would be a reasonable estimate.

Now another calculation.

Assume that a name and address require about 100 characters. How many names and addresses can you get onto a floppy disc? Answer: about 8000. Extend this calculation to the 60 million or so people who live in the UK. How much memory storage do you need? The answer (using today's Gb capacity hard drives is "Not a lot")!

One last calculation.

Assume a typical word consists of six characters (including spaces and other punctuation) and that the Archive magazine (without pictures) consists of about 60,000 words. You'll see that without pictures (and no compression) two editions of Archive can be fitted on a floppy disc!

The text of a Gerald's Column article is usually between 10 Kb and 15 Kb.

## **The Data Input Bottleneck**

So where am I going with these seemingly random but, perhaps, interesting calculations?

I have said that the initial use of home computers was restricted to applications for which the amount of data typed into the machine was relatively small ("Is 1234567891 a prime number?") but for which much (arithmetic) processing was required. The computer program was always much larger than the data. Typing the program always took much longer than did entering the data!

When computer uses moved from sums to word processing the time spent entering the data became a much larger proportion of the total time it took to do a job. Indeed, the sort of word processing program which a user would describe as "responsive" is one for which the CPU would be completely idle for a large proportion of the time. The emphasis moved from the CPU as a fast number cruncher towards the responsiveness of the screen display.

Even in the earliest days of word processing (remember WordWise?) the size of the data file on disc and in memory often exceeded the size of the word processing program. With no pictures it would be possible to store a couple of issues of Archive on an 800 Kb floppy disc with plenty of room to spare.

A point which is worth making is this. If your interest is in number crunching then a faster CPU does help but when it comes to word processing (with no pictures as it was with WordWise) you do not need a computer with a fast CPU. What you do need is storage space both in Random Access Memory (RAM) and on disc.

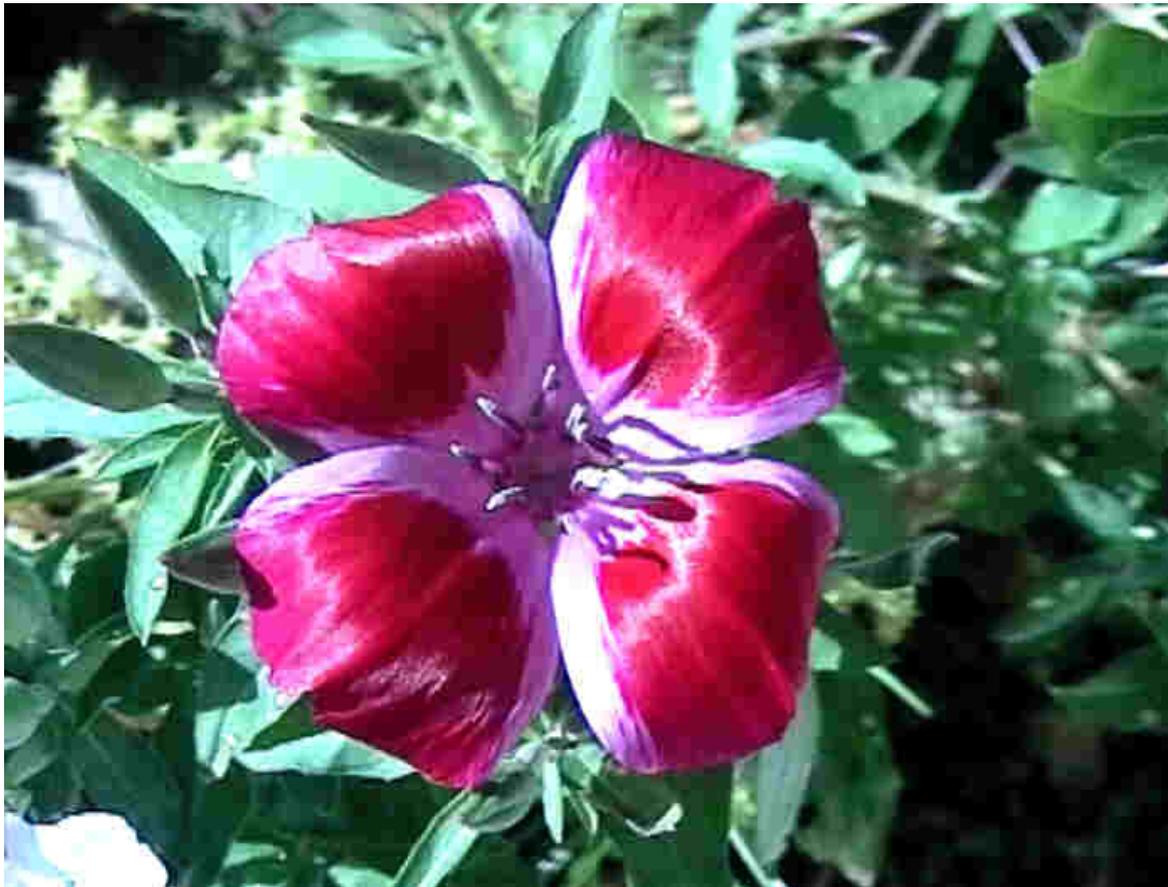
In those days (of word processing without pictures) a 10 Mb hard drive was considered enormous. I remember setting up an appointments system for a hairdressing business in which every appointment for more than a year was stored on a 10 Mb hard drive with lots of room to spare. The computer which I used for this was a humble BBC Master with only 32 Kb of RAM. I don't know the speed of those early machines but I think that the CPU ran at a few Mhz rather than the Ghz (a thousand times faster) that they do now.

## Pictures

It is said that "a picture paints a thousand words." Let's do the sums and find out.

Let's consider a picture taken by a digital camera rather than a screen shot such as those which I have often included in my articles for Archive. Furthermore let us not consider the use of compression (yet). My example (shown below) is a snapshot taken using my digital camcorder as a digital camera. This digital camcorder, like nearly all others, stores pictures as images which are 696 x 532 pixels and with what is called a 'depth of colour' of 24 bits (3 bytes) or 16 million colours. My camcorder can be used as a  $696 * 532 = 0.37$  Mega pixel digital camera. I shall use the abbreviation Mp for Mega pixels.

Although 0.37 Mp might not seem large these days it is quite adequate for a lot of uses such as displaying a picture of a flower from my garden. I would like you to note this next fact. Instead of typing at a keyboard for a hundred hours, I can generate a file of the same size in seconds using a digital camera such as my 0.37 Mp digital camcorder.



Those who know what this flower is will be able to appreciate it from this picture even though a 0.37 Mp camera is regarded as one having low resolution. I am sorry but I can't remember the name of this flower; perhaps someone who knows what it is will email me and tell me?

This picture will appear in Archive in monochrome, probably 256 shades of grey, but, on my screen it appears in 24 bit colour. That is 3 bytes, for every pixel. As a sprite file it is nearly 1.5 Mb! If we use as our rate of conversion 6 bytes (that is 6 ASCII characters) per word (we're not considering Unicode coding, a 2 byte code) then this picture takes up the same amount of space on disc (and in RAM) not as 1000 words but  $(1\ 500\ 000) \div (6) = 250\ 000$  words! Even in 256 shades of grey this picture is worth over 80 000 words!

## Consequences

So where am I going with these calculations? You've guessed it. As soon as we start loading pictures into an article prepared using a desk top publisher such as Impression or Ovation, the storage space required (on disc and in RAM and in the screen memory) for the (ASCII) words in our article pales into insignificance compared with the space used by the pictures.

For this particular Gerald's Column the original, 24 bit, uncompressed pictures total more than 21 Mb whilst the text, the single byte, ASCII coded words, amount to less than 15 Kb.

But that is not all! (I just love the way this phrase is repeated in "The Cat in the Hat"!)

Not only do we need disc space (I can't get my 1.5 Mb picture onto an 800 Kb floppy even though such a disc would happily take a couple of copies of Archive without pictures—and how long to type?) but we need to consider what is involved in shifting these pictures around.

They have to be moved from disc to RAM and then, after some processing by the CPU (called rendering—this is required to fit the picture into a graphic frame) the modified picture data has to be moved into the screen memory. I shall refer to this screen memory as VRAM (Video Random Access Memory).

Once we start to include pictures as well as words in a document, particularly pictures using 24 bits per pixel, then we'll need a lot more disc space, more RAM and more VRAM.

However, (to quote the Cat) "That is not all. No! That is not all!".

Including pictures in our documents also needs a CPU which works harder (meaning a greater proportion of the time) and which is hundreds of times faster than one which is quite adequate, even when just ticking over, for a word processor. Rendering pictures (from RAM to the screen memory, VRAM) really stretches the processing power of our CPU.

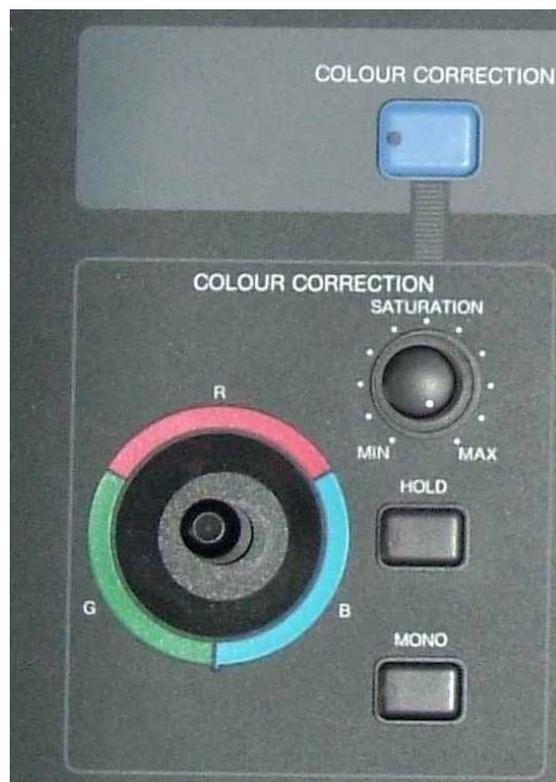
## Even Bigger Pictures

One of my most recent acquisitions is a digital camera with 2832 x 2128 pixels. Multiply this out and you'll find that it is something which can be described as a 6 Mega pixel camera. At 3 bytes per pixel (24 bit colour depth, sometimes referred to as 16 million colours) the uncompressed file from the camera is about 18 Mb. My camera has such an uncompressed mode (many digital cameras store only compressed files). Of course I have the means of transferring this 18 Mb file from my camera to the computer I use to process it.

The shot shown below has a resolution of 2832 x 2128 pixels and a colour depth of 16 million colours (24 bit colour). As a sprite this picture file is a little over 18 Mb—and I can transfer it from my camera to RAM and then to disc 'in a flash'! Furthermore I can use the CPU to render it into screen memory where I can use the zoom function to look at any part in detail.



You won't appreciate the high definition of this picture just by looking at the monochrome printed version you will see in Archive. You will need to download the article and pictures from the web site. This originally 18 Mb worth of picture (the one above) shows you what one of my analogue video processors looks like. I use it to edit video footage from my camcorder. The set of controls at the bottom left can be used to adjust the saturation and hue (for example to correct a poor colour balance) of a video film before the edited output is sent to another video recorder.



I used a technique called 'cropping' to extract this second picture from the first. Let me emphasise that it is not a second snapshot but part of the same one. This extract is 544 x 770 pixels and 24 bit colour (16 million colours). Consequently its size is a little over 1.2 Mb.

I loaded the first picture into a suitable program and then cropped the area I wanted before saving it to disc. Doing an operation like this needs a lot more RAM, VRAM, disc space and CPU processing power than would be needed to produce a pictureless word processed document equivalent to a year's supply of Archive. What is more, the original data input of around 18 Mb can be created and transferred 'in a flash'! Unlike entering text for a 'book' of hairdressing appointments, it is the processing which takes the time, not the data input.

Even though Paul will have reduced this snap to 256 shades of grey, you should still be able to appreciate that it is the high resolution of the 18 Mb original photograph (2832 x 2128 pixels) which has allowed me to 'zoom in' on a section of about 7% of the original area and, I hope you will agree, it still provides you with a picture of better than acceptable resolution.

## **I Have Cheated**

Usually I send my Gerald's Column article to Paul in Impression format. I have not done so this time. The reason is that (without special tools which I and many other users of Impression do not have) Impression stores pictures in uncompressed format. If I were to send Paul the Impression version of this article complete with pictures, it would have been 21 Mb. I send Paul my Column over the Internet and it would take a long time to send such a file even at my maximum dial up rate of roughly 4 Kb (4000 eight bit bytes) per second. Indeed, a quick calculation indicates that it would take about 90 minutes to transfer this 21 Mb article by 'phone using the Internet.

So what have I done in order to send Paul a document with pictures?

Rather than use Impression I am using Fireworkz. I know that Paul has Fireworkz because he has recently bought an Iyonix and is using it to produce Archive. Sending him the article in Fireworkz format rather than Impression format will cause him no pain. He strips out the text, does some processing on it and then loads the resultant text into his Impression template.

But what does he do with the pictures? If I send Paul my article (with pictures) in Impression format then he saves the pictures from my file, processes them separately from the text (not using Impression). He inserts the processed pictures into frames into his newly created Impression document. So there is no pain for Paul if I send him the pictures as pictures which are not included in my Fireworkz document—but I haven't done that!

The feature of Fireworkz which I am using (because I don't have the special tools to do this in Impression) is the facility to display pictures which are in JPEG (Joint Picture Expert Group) format. The JPEG pictures are dragged into Fireworkz in exactly the same way as a sprite or drawfile and the program is able to render them on screen. Eventually they can be printed out exactly where they appear in the Fireworkz document.

By the way, Ovation will render JPEG files without special tools. Perhaps when you get around to considering your next computer you will decide that you need a desk top publisher which is able to render not only JPEG files but picture files of many other formats as well?

JPEG is a compressed format. By using this JPEG compression utility I have converted the 21 Mb worth of sprites into about 400 Kb of JPEG format files.

JPEG is a highly flexible format. The utility I have used offers a powerful set of options. I can reduce the number of colours, I can change the number of pixels and I can change the degree of compression.

I have retained the 24 bit colour depth, I have retained the 6 million pixels but I have applied a modest amount of compression. In my personal, subjective view the amount of compression I have used is hardly noticeable when it comes to studying the detail in the picture. Indeed, I have tried to fault the JPEG by zooming in on what you might think of as 'tricky bits' and the processing I have used has passed with flying colours!.

Unlike Impression, Fireworkz offers the choice of either referencing or embedding the JPEG format pictures. Each technique has its advantage and disadvantages. Let's leave that too for another day. In this particular case I have sent the JPEG files separately from the text and referenced the pictures so that the pictures appear as if they are part of the Fireworkz document even though they are stored separately on the disc.

The textual part of my Fireworkz document, including all the formatting commands and Styles, is only 24 Kb whereas the JPEG format pictures account for more than 400 Kb.

## **Summary**

Let me emphasise this month's key points and ask you to think about them.

It was the fact that computers were built with more RAM that has allowed us to progress from doing sums to word processing. Then newer computers were released with even more RAM and VRAM and a much faster CPU. These advances have allowed us to make the big step from using only ASCII coded characters in our documents to the inclusion of 24 bit coloured pictures consisting of millions of pixels.

It would have been impossible to process 18 Mb picture files on the wonderful but limited 32 Kb RAM BBC B. It needed the power of an Archimedes, and a faster, bigger Archimedes (an A540 at least), to move on from words to (still) pictures.

Data input in the form of typed text is slow. For example it takes, say, an hour to type in even 10 Kb at the keyboard; or a full day to type the text for a typical issue of Archive.

It is the digital camera that has provided us with the means of capturing and entering files which are huge compared with text files. It is this massive increase in data input speeds that has driven the demand for computers with more RAM, VRAM and faster CPUs. I have to say that having tasted what can be done with a digital camera I know that my next computer will have to have enough RAM, VRAM and CPU power to process them quickly.

## **The Future**

Allow me to return to my theme which, in its least controversial form, I phrase it as the question: "What will you use your next computer for?" My next paragraph contains a hint which might allow you some insight into what I believe to be the nature of the road ahead.

Of course, your comments (and guesses) about your own future uses of a computer will be most welcome. As I said earlier, the lesson of history is that it will not be more of the same thing but something different, something not possible with the computer which you have now.

In the days of limited data input rates (typing at a keyboard) there was no need for computers with lots of memory and fast processing speeds. The BBC computer was totally adequate for all our needs because the time taken to fill it with data using a keyboard was measured in hours rather than milli-seconds.

Digital cameras and scanners have provided the means of generating data (for input to the computer) at a rate which is ten thousand or even a million times faster than a keyboard. Pictures in desk top published documents need a computer which has more RAM, VRAM and CPU power than the early BBC machine because picture files are much larger.

So I ask “What applications require data rates which are faster than those needed to capture the data generated by a digital camera?” Whatever it is, it will require faster processing.

### **Communication**

Please contact me by email (preferred) or by letter if you have any questions or comments. Please email me at <Archive@abacusline.demon.co.uk> and not <gerald@abacusline...>.