Introduction to Digital Photography

Lesson Aim

To understand the scope and nature of digital photography.

Conventional and digital photography are in many ways very similar, but in just as many ways, quite different. Both have their advantages and disadvantages, however digital has become popular not only with professionals but also amateurs. There are less people practicing in traditional photography as well as less access to its expensive products and services.

Conventional film photography, using chemically photo-sensitive film is a well-known and highly developed technology. We know how to use it, how to get the best out of it, and how its life span can be optimised because it has been used and developed over a long period of time.

Digital photography is a relatively new and continuously improving technology, which records images in the form of digital (i.e. 2 digit or binary) codes. In simple terms digital codes are similar to Morse code. One number or digit is indicated by a pulse of electricity, a second digit is indicated by no electrical pulse. By combining these pulses and lack of pulses into codes, we can, for example, create representations for letters of the alphabet allowing us to write language or text on a computer. When we combine these electrical "pulses" and "no pulses" (or 'ones' and 'zeros') in more complex combinations, we can create more complex representations. These can include the colour, and degree of darkness or brightness in a single spot on a picture. When huge quantities of such dots are combined together, into a grid or array, we can then create a digital picture. (This is basically how digital photography works!) Each dot is referred to as a pixel (PICTURE ELEMENT) and is represented by 'bits' of data – thus the digital image array is often referred to as a 'bitmap'.

By zooming in on a digital image we can see it is made up of tiny squares, the pixels. Try this if you have a digital image on the computer. If an image size is 400 x 200 this means the image has 400 pixels across the width and 200 pixels in the height, and totalling to 80,000 pixels. Each pixel is made up of one colour.

Digital photography is always improving and its imagery has now overtaken traditional silver halide based photography. With the speed that digital technology has enhanced it is a reality that one day traditional photography will be totally redundant, although there may remain the few traditional based photographers. Todays digital cameras now make it possible to create high resolution images with the added attention to detail.

A digital code stays a code until it is interpreted into an analogue artefact by the use of hardware and software. Consequently digital can be copied directly to digital and reading the code is largely unaffected and this opens the way for simple, cheap archiving of digital imagery. Digital storage systems can even be arranged so that if data is lost through damage or equipment failure, the missing code can be reconstructed by analysis and comparison of the remaining pieces of data. In essence this means that the digital image you create today can be preserved with no loss or deterioration into the foreseeable future

by simply copying the file to new media. With the exception of some very simple and relatively cheap cameras, many of the early problems of digital have been eliminated or have become largely irrelevant.

For example, all but the most basic digital cameras in a mobile phone now have image sensors capable of giving high enough resolution for good quality A4-size prints; or in other words, to meet the 'holiday snap' expectations of most non-professionals. When you take a digital photo the image is captured by a sensor which is actually an analogue device. The actual digitising process and writing of the image data to memory take time. This means that some digital cameras cannot shoot a rapid sequence of photos - you have to wait 5 or more seconds between shots. For most people this presents no more of a problem than waiting for the flash unit to recycle on a conventional camera if you were, for example, shooting in dim light. However for the professional, where 'motor-drive' shots are an expectation of their shooting hardware, high end digital cameras now employ fast memory buffers and new sensors to allow sequences of five or more images to be fired-off at a time. Increases in the speed with which an image can be scanned from the sensor and processed have also helped eliminate this problem. These facilities come at a price and digital cameras are still more expensive than their conventional counterparts. As time progresses, this price gap is diminishing.

Significantly, digital cameras are based on conventional cameras for their exposure systems. Depending on the degree of sophistication, modern digital cameras provide the same, if not more, image controls as any standard film camera. The film speed, shutter and aperture systems of ‘old style’ cameras are an integral part of all but the simplest point-and-shoot digital hardware. The range of digital cameras now covers a similar scope to film, if not more. We now have, as well as DSLR cameras, digital medium and digital large format cameras which can shoot exceptional quality and attention to detail. These, of course, can be very expensive!

Digital cameras store images on memory cards which vary depending on camera type. The most common way to store images from a digital camera is to 'download' them from the camera’s memory card onto a computer hard drive. This then allows the camera memory card to be re-used over and over again. Digital photography is computer friendly and inexpensive, once you have the equipment. You can take any number of photos, place them onto a computer, and manipulate the images to use them in different ways, change effects and even send the image via the internet quickly to any part of the world and store them on clouds. Mobile phones and other portable devices now can post images online within seconds and the sharing of images has led to an extreme growth in photography and social media. Other editing services have also developed for mobile devices, like Instagram, all mimicking similar feature to software that can manipulate images on your home computer but focused on the growing online market.

THE DIGITAL REVOLUTION

In recent times, the most important technological breakthroughs in electronics have been part of one larger breakthrough. CD’s, DVD’s, Digital Televisions are all built around the same basic process of converting conventional analogue information (represented by a fluctuating wave) into digital information (represented by 1s and 0s, or bits).

The digital camera is one of the most notable instances of this shift because it is by far different from its predecessor. Conventional cameras depend entirely on chemical and mechanical processes. All digital cameras have a built-in computer and all of them record images entirely in digital form.

Here are just some advantages and disadvantages of working with digital cameras.

Advantages

- Gain quality control over your pictures**.** Conventional photos have no input into an image after it leaves the camera. With a digital photo, image-editing software can be used to restore your pictures, if necessary.
- View the photos as you are shooting.
- Once equipment is purchased, it is relatively inexpensive.
- Store all photos easily onto a hard drive, cloud or removable device.
- Can be as high quality as film, if using the correct equipment.
- Unlike film, digital images are not susceptible to scratches or damage.
- Send an image to friends, family members, and clients almost instantaneously by attaching it to an e-mail message or social network.
- Explore your artistic side. Using image editing program you can apply special effects.

Disadvantages

- Lower priced cameras deliver lower resolution images. More expensive cameras deliver quality.
- Once you press the shutter button on a digital camera, the camera requires a few seconds to store the image to its memory, although this is rectified in more professional cameras.

CHARACTERISTICS OF DIGITAL

Analogue versus Digital – What's the Difference

Analogue systems record information about the world by creating an analogue of the reality we perceive normally through our senses. For example, when we take a silver image photograph we create a pattern of latent chemical changes in the emulsion layer of the film which through development can be made visible.

The camera negative, in the case of a black and white image, resembles the original to the extent that we can hold up the image to the original scene and, although the tones are reversed and the colours turned to shades of grey, we can see obvious similarities between the two - so much so that we usually can recognise the negative as a representation in two dimensions of that original scene. The recorded scene is similar to, but not the same as, the original.

So what about digital? The key word with digital, the word behind all aspects of computing, is "code". Did you ever as a child make up sentences by transposing letters to a pattern? You couldn't understand the sentence until you had the code key - the secret to how it was encrypted. The important thing about this is that, unlike an analogue system, the information bears no logical resemblance to what you are seeing and hearing on your computer monitor. Without the necessary hardware and software we cannot interpret digital information as anything but 'noise' or, if it could be printed out in its raw form, page after page of coded figures.

Computers work with binary code, a system of ones and zeros or 'ons' and 'offs'. Every piece of information that the computer represents as text, graphics or even video is still made up of a code consisting of ones and zeros which are given meaning and value by the computer software. Computers attain their complexity of operation by being incredibly fast at processing these 'on' and 'off' signals and being able to decode them to a logical meaning. The simplest element of the code is a 'bit' which can have the value 1 or 0. If we have two bits the range of values we can represent goes up from two to four as we can have the two bits combined as 00, 10, 01 or 11. Three bits gives us 2 X 2 X 2 possibilities, and so on. The smallest block of data normally dealt with by a computer is a 'byte' (BINARY TABLE) which, at 8 bits, is enough to represent a character in text or to give us 256 colour possibilities ("codes" if you prefer) in a digital image. Digital imaging is literally painting by numbers!

Pixels, Bits and Colour Depth

Digital images, as we have already discovered, are made up of a large number of picture elements called "pixels".

Pixels are assigned colour and brightness values by the process and encoding of the raw information from the camera's image sensor.

Most cameras (and most monitors with newer computers) operate at the level of 24 bit colour. This means the image can contain 16,777,215 different colour shadings as opposed to the 256 possible with 8 bit colour or the 65,536 possibilities with 16 bit colour.

Recent advances in high end cameras have taken us to the level of 36 bit colour and therefore into literally billions of colour shadings. As a rule, the higher the colour depth (also referred to as the bit depth), the better the image's colour quality, and, in fact, the more detail that will actually be visible in the final image, as increasing the number of colour shades available increases the subtlety and accuracy with which any detail can be represented.

Pixels and Resolution

The resolution of a digital image is governed by the capabilities of the camera sensor used to capture it and by the way it is printed. The absolute resolution of an image depends on the number of pixels in the image sensor of the camera. Webcams and older digital cameras frequently have no better resolution than 640 by 480 pixels (640 wide X 480 high), or that of a PAL video image. Get close to your TV and you'll see that unless the image is kept small, this is not up to "photo quality". (Photo quality essentially means an image that has equal or better resolution than you would expect from an image on a 35 millimetre camera using medium speed – 200 ISO – film). Image sensors on digital cameras are quoted as having a maximum pixel resolution of, for example, 1.4 megapixels (or 1,400,000 pixels).

In terms of actual resolution in the final print, a 1.4 megapixel camera should produce a print size up to postcard. Lower end cameras should be capable of at least this resolution. High end professional cameras of similar size and operation to a 35 mm SLR can use sensors as large as 24 megapixels and more, which are capable of good image quality. Newer, and higher end models can now have 51.4 megapixels. The simple fact is, that the quantity of megapixels available in cameras varies greatly. A large quantity of megapixels is not the only determinant of image quality. The type of lens used should also be carefully considered.

Colour and Black and White

All colour images can be converted to black and white before printing, and so the issue of whether to shoot one or the other is irrelevant in digital photography.

The Two Colour Systems

Almost all colour images are made up in one of two ways, RGB or CMYK. In the early years of colour photographic processes such as the Lumiere autochrome utilised a process called additive colour. Additive colour uses the three primaries, red, green and blue to make up the image. If red, green and blue lights are projected onto a white object, where all three overlap white light will be created. Colour television systems utilise additive colour to produce colour images.

At the same time as it was realised that red, green and blue could be used to create full colour images it was also realised that a complementary set of colours, called the subtractive primaries, existed. These colours, cyan (blue-green), magenta and yellow when overlapped together effectively block white light and create black. Digital cameras, scanners and computer monitors utilise red, green and blue (RGB) colour to produce their images. Colour printers utilise subtractive primaries to create colour on a page. This is logical as RGB colours work to reproduce colour when they can be made luminous together to create colour combinations for our eyes, out of what is essentially a black space. CMYK (the K stands for black, which is added to enhance the image as cyan, magenta and yellow tend to create a somewhat muddy black in actual printing) is the logical choice for printing where the background is usually white. This means that your screen image undergoes a re-encoding to allow the printer to make sense of the RGB image for CMYK printing. In reality this is a minor problem and, in high end digital imaging, calibration programs to make sure screen colour matches printed colour have been developed to ensure total colour accuracy.

APPLICATIONS FOR DIGITAL PHOTOGRAPHY

Graphics

Home computers have programs and screens that allow for image presentation in quality. Computer graphics, incorporating digital photography, can be used for creating business presentations, signs, newsletters, graphics for television and a host of other applications. You can also incorporate photos, logos and diagrams into word processor documents. With a computer, scanner, inkjet or laser printer, and some talent, you can replace the need for hiring a printing agency.

Photo Application Software

Software such as Photoshop can be used to apply post editing to photographs. The limits are endless with digital photo editing, from simple adjustments to exposures to cutting on section of a photograph and placing on another.

Computer-Aided Design (CAD)

Computer programs and systems have been developed which can be used in designing, planning, adjusting and outputting models and images for a range of fields such as engineering, manufacturing, architecture, interior design and science. Some products or concepts which are designed or planned using CAD applications are tools, cars, planes, residential and tourist developments, molecules and drugs, electronic circuits and hundreds of other things.

The process usually involves the direct input of information (lines, symbols, figures, etc.) using keyboard, mouse, light pen or graphics/digitising tablet. The CAD software enables the images to be viewed in two or three dimensions and to be manipulated by moving, twisting, editing or otherwise changing the data or image. The image can be displayed as a 'skeleton' or wire frame, shaded, or made solid.

Images and input from scanners can be utilised in CAD programs, particularly where walk-through and virtual environments are created and can be modelled around images acquired in the field.

Multimedia

Multimedia combines the media of video, audio, text, animation and graphics, frequently incorporating user interaction.

One example of this is a multimedia encyclopaedia. All the data in the encyclopaedia is stored on a CD-ROM (READ ONLY MEMORY) that can be read by the PC (CD's can be used to store audio, such as that found on music CDs , but can also be used to store the data that computers read as program files). You read the encyclopaedia by using the computer to enter the topic you are interested in. Up pops a description and picture and, possibly a button to allow you to play a relevant audio or video associated with the entry.

Video games

The industry of video games has been said to rival that of the movie industry. Digital Photography is often used to help create complex 3d environments for video gamers to play in that mimic the real world.

Social Media

Online communities have advanced rapidly and allow the ability to share images with family and online friends. Social networking sites like Instagram, Facebook and Snapchat all allow the images to be stored and shared.

Video

With Cannon release of the digitals SLR the 5d Mark 11 in 2008 some say became the birth of a new era in digital film or videography. This was one of the first high quality DSLR cameras that could take quality video. This meant that expensive lens used for still photography could now take high quality video

Digital Terminology

Aperture Priority

Desired lens opening (f-stop) is manually selected and locked in; the camera then chooses an appropriate shutter speed for proper exposure.

Artifacts

Unwanted effects in the image such as blotches (from over-compression), Christmas tree lights (multi-coloured speckles from bright highlights), noise (granularity from underexposure) and other aberrations that sometimes afflict digital images.

Buffer

Temporary electronic storage area. Several already-exposed digital images can wait in line to be processed. This speeds the interval between shots since each photo does not have to be processed before the next one can be taken

CCD

Charge-coupled device. The sensor array that makes up the imaging surface of the digital camera. The more sensors a CCD has, the higher the image resolution will be.

CMOS

Complementary Metal Oxide Semiconductor. Used in some digital cameras instead of CCDs because they have low power requirements and are less expensive.

Compact Flash

A matchbook-sized memory card used in many digital cameras today and presently capable of storing over 200MB of information.

Compression

Reducing digital camera picture file sizes in the camera after they're shot, usually according to Joint Photographic Experts Group (JPEG) specifications so more images can be stored on the memory card.

Digital Zoom

An electronic enlargement of part of the image making it appear to be closer and bigger, simulating an optical zoom lens at a telephoto setting. The image is actually cropped, resulting in loss of surrounding pixels and decreased resolution.

Info-Lithium

A Lithium-Ion battery that indicates its remaining shooting time in minutes on the digital cameras LCD Monitor screen.

LCD Monitor

The Liquid Crystal Display colour screen on most digital cameras usually 1.8 to 2.5 inches measured diagonally and used to check images after they are shot.

Megapixel (also MP)

When the length times width of a digital camera pixel array reaches one million, its resolution is then described in Megapixels. 1,300,000 pixels equals 1.3 Megapixels.

Noise

The electronic equivalent of excessive grain in a film image.

Optical Zoom

Zoom lens which uses movement of lens elements to achieve various fields of view.

Social Media

Internet based networks of registered users who choose to connect with each other and communicate via these networks on regular basis. E.g. Facebook, Twitter, Google Plus and Flickr

SET TASK

Investigate the scope of digital photography, at this point in time, in your locality. You might do this using any or all of the following methods:

- You might look at articles written about digital photography in online, magazines or newspapers.
- You might speak with people who work in industry (e.g. printing, publishing, graphics, advertising, or computing) and ask them what the latest is with digital photography and how it is used in their industry. Perhaps approaching members of a local Camera Club.
- Visit a shop that sells equipment used in digital photography, look at a demonstration of the equipment, and discuss its use with the salesperson.
- Go onto the web and do a search for issues related to digital imaging – e.g. new developments, new cameras, current applications, available software.

Make notes of the things you learn and impressions you gain about digital photography.

Look at things like, camera sizes and trends, lens technology and ways of outputting your images.

Assignment 1

Question 1.

List some advantages and disadvantages for both film and digital photography.

Question 2.

Briefly explain any experience or prior knowledge which you have that is relevant to digital photography.

-Tell us about any equipment you own, or you have used or seen.

-Tell us about anything you have read.

-Tell us about any courses which you might have studied, or any related experiences.

(Write no more than quarter of a page).

Question 3.

Explain your own impressions on the scope on digital photography. Use the information you gained from your set task, together with any other experiences you have had in the past.

(Write no more than half a page).

Question 4.

Why does RGB need to be converted to CMYK for printing?

Question 5.

Explain, in your own words, what pixels are in digital photography. Explain this in one paragraph.

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