

The Beginners Guide To Understanding Digital Photography

By Rocky Tapscott

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Advantages of Digital Photography

Digital technology is finding a place in almost everyone's lives. From digital music to digital movies we are constantly exposed to images and sound that have passed from the traditional analog domain into the new digital formats.

Digital photography is one of those formats and is becoming more popular every year.

There are lots of reasons for that popularity. Digital photographs are incredibly versatile. You can send them to friends and family by email, post them on a web site, transfer them to CD, store them on your computer, and use them for slide shows, which can be viewed on your TV or computer monitor.

They can of course be printed, and not just as traditional 4x6 pictures. They can be used to make personalized calendars, greeting cards, and even be printed on objects like coffee mugs and t-shirts.

For many people, the biggest advantage of digital photography is that it eliminates the need for picture processing. No more trips to the photo store – pictures can be viewed almost instantly on the display screen of the camera.

Since there is no developing, digital photography doesn't need dangerous chemicals that could end up in our water supplies.

Another big advantage of digital photos is the ease with which they can be edited. Computer software allows digital images to be altered in any way imaginable.

They can be cropped, the colours can be changed or enhanced, the contrast can be adjusted, imperfections can be removed, and images can be combined to create startling new designs.

All this can be accomplished in a few seconds with just a few keystrokes or mouse clicks.

Using a digital camera is the best way to take advantage of all the features of digital photography, but you can also use a traditional film camera and convert your negatives to the digital domain.

If you are uncertain about whether or not to take the digital plunge, converting negatives allows you to get a taste of the wonders of digital photography without investing in new equipment. Most photo developing stores offer this service.

Digital cameras, however, offer so much more than film cameras. They have a viewing screen which functions as both a viewfinder and a picture viewer. This means you can preview pictures you've taken just seconds before.

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If you don't like it just delete it, or if there is a section that is good, crop it before saving it back to the camera's memory. Many digital cameras also function as simple video recorders that can capture video along with sound - anywhere, anytime.

All this must come at a hefty price tag, though - right? Wrong! Digital photography is becoming more affordable every year, and the technology to make fabulous photos is well within the reach of the average consumer.

Add in the money you'll save in development costs and you have an affordable, practical, solution for all your photography needs.

How a Digital Camera Works

Digital cameras are quite similar to traditional cameras in their operation. They both have a lens to focus the image, a shutter to allow light inside the camera, and an aperture to control the amount of light which enters the camera.

The differences between digital and traditional photography occur after the light enters the camera. A traditional camera captures the images on film, while a digital camera captures the image on an image sensor.

Image sensors are electronic devices made up of an array of electrodes (or photosites) which measure light intensity. The most common type of image sensor for digital cameras is the CCD (Charge-Coupled Device) although others such as CMOS and Foveon are sometimes used.

The number of photosites in the image sensor gives the digital camera its megapixel (millions of pixels) rating. Each photosite corresponds to a pixel in the final image, so a camera which is rated at six megapixels, for example, has an image sensor which is 3008 pixels wide by 2000 pixels high.

When light hits the image sensor it is converted into electrical signals which are amplified and fed to an analog-to-digital (A/D) converter.

The A/D converter changes the electrical signal into binary numbers which are processed by a computer housed in the camera body. Once the numbers have been processed the resulting image is stored on a memory card.

Photosites can only measure intensity of light -- not colour. In order to produce a colour image, each photosite must be covered with a coloured filter which can be red, blue, or green. These are the three primary colours which can be combined to produce any other colour including white.

The coloured filters are arranged in a grid so that there are twice as many green filters as there are red or blue. This is because the human eye is twice as sensitive to green light.

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Filters are arranged in a pattern called the Bayer pattern - one row of red, green, red, green (etc.), and the next row of blue, green, blue, green (etc).

Since each photosite can only be covered with one coloured filter, computer processing is necessary to produce a full coloured image. This is done by analyzing each individual pixel and its immediate neighbors and producing a composite colour from these calculations.

For example, if a bright red pixel is surrounded by bright green and bright blue pixels, the bright red pixel must actually be white, because white is the combination of red, blue, and green. This process is called demosaicing.

After demosaicing the image is adjusted according to the settings on your camera. Most cameras have settings for brightness, contrast, and colour saturation. After these adjustments are made some cameras may also apply a sharpening algorithm to make the image clearer.

The final step before saving the image on the memory card is to compress it. Most cameras use JPEG as a compression format. This reduces the size of the file by eliminating excess data. This data cannot be recovered, so JPEG is called a 'lossy' format.

Many cameras have the ability to save uncompressed images as TIFF files or raw data.

Raw data is the original photosite data even before demosaicing. It can be transferred to a computer for processing with special software that will perform all of the processing functions of the camera but with much greater control.

Classic Photography vs. Digital Photography

Even though digital photography is a revolutionary new way to take pictures, it is very much based on traditional photography and uses many of the same principals.

Both types of photography require a lens to focus the light and a shutter to allow the light to enter the camera. The main difference between digital and traditional photography is how the image is captured.

Traditional photography uses film which must be developed in a darkroom using various chemicals. The developing process produces 'negatives' which must be printed before you can see the picture.

Digital photography uses an electronic sensor to capture the image. The sensor is made up of millions of individual 'pixels' (picture elements) which convert light into a number. Rather than waiting for the picture to be developed, digital pictures can be seen almost instantaneously on the viewfinder of the digital camera.

The Beginners Guide To Digital Photography

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The quality of a digital photograph depends a lot on how many pixels it has. The number of pixels is sometimes referred to as the 'resolution' of an image, and can be expressed as a dimension (800 x 600), or the number of pixels per inch.

A common resolution for computer screens is 800 x 600 and this means the monitor can display 800 pixels from side to side and 600 pixels from top to bottom for a total of 480,000.

Digital photography commonly uses much higher resolutions than computer screens with resolutions in the millions of pixels (megapixels). A camera with a resolution of 2048 x 1536 has a total resolution of 3.1 megapixels.

As mentioned above, each pixel is represented by a number. The size of that number determines the colours scale that can be represented. For example, black-and-white pictures can be represented with pixels which are just eight bits in length.

If you are familiar with binary arithmetic, you know that an 8-bit number can represent decimal numbers from 0 to 256. Black-and-white photographs, therefore, can have a total of 255 shades of gray as well as black (0) and white (256).

Colour must be represented with larger numbers. 16 bits per pixel, for example, is necessary to have a colour scale of 65,536 different shades. 24 bits per pixel can represent more than 16 million different colours.

Most digital cameras use 24 bits per pixel, but some professional equipment has a colour resolution of up to 48 bits per pixel for more than 280 billion different shades.

There are several factors that affect the quality of a digital camera, but pixel resolution is usually seen as the most important. Choosing an adequate pixel resolution depends a lot on the size of the photographs you want to print.

Keep in mind that the number of pixels in an image does not change, so pictures with larger dimensions will have fewer pixels per inch which results in a loss of detail if the picture size becomes too big.

Photo labs usually print pictures at 300 pixels per inch, so using this as a standard measurement you can calculate how many megapixels your camera should have.

The maximum print from a two megapixel camera at 300 pixels per inch is 5.8" x 3.8" -- less than the standard 4" x 6". A camera with four megapixels can print pictures to a maximum size of 8.2" x 5.4" at 300 pixels per inch.

Of course, there is nothing to stop you from printing larger pictures. Pictures printed at 200 pixels per inch are slightly less sharp but still quite acceptable for many purposes. At this resolution, you can get pictures up to 8.7" x 5.8" from a two megapixel camera, and 12.2" x 8.2" from a four megapixel camera.

Your Digital Camera Buying Guide

Are you ready to take the plunge into the world of digital photography? This series of articles will help you choose the best camera for your needs.

The first thing to consider is why you want a digital camera. The answer to this question will form the basis of all your other buying decisions.

If you simply want to send snapshots by e-mail or post images on the Internet, you don't need a high-resolution camera. If you want to print digital photographs, however, you need a camera with more resolution.

Resolution

Digital cameras are rated by the number of megapixels (millions of pixels) they can record. This is also referred to as their 'resolution' and is the single most important factor affecting the price of digital cameras. Quite simply, the more megapixels the higher the price.

Images which are only viewed on a computer screen did not need a high resolution. A computer monitor set to 1280x1024 (which is very large) is only displaying about 1.3 megapixels. Any digital camera rated at about two megapixels is suitable for computer images.

Printed pictures, however, are another story. Professional photo shops usually print photographs at 300 dots per inch, and you are likely to be disappointed with pictures printed at less than this standard.

A 4 x 6 photograph printed at 300 dots per inch needs an image which has about 2.8 million pixels. That means that digital cameras that are meant to be used for printed pictures should be rated at least three megapixels.

More megapixels doesn't necessarily mean better pictures. All other things being equal (image sensor quality and lens quality) a camera with more megapixels simply allows you to print larger pictures. You also have more options for cropping photos and maintaining standard print sizes.

Budget

Now that you have chosen a minimum megapixel rating, you can look for cameras which fall into your budget.

You will most likely want to get the best quality images for your money, and that may mean foregoing some of the fancy features such as video and sound recording. Concentrate on lens quality and image sensor quality.

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Lenses are available in either plastic or glass. Glass lenses are superior and will produce crisper, cleaner images. The best cameras will be equipped with lenses by well-known manufacturers such as Leica or Zeiss.

Many digital cameras have a zoom function which allows you to get closer to your subject without moving the camera. There are two types of zoom -- digital and optical.

An optical zoom changes the actual length of the lens. Digital zooms simply remove the outside edges of an image and interpolate the result over the area of the image sensor. They do not give as good results as optical zooms and should be avoided if possible.

Image sensors are electronic devices that record the images. The two most popular types are CMOS (Complementary Metal Oxide Semiconductor) and CCD (Charged-Couple Device). CMOS is the cheaper of the two but the image quality is inferior to CCD.

No matter what your budget, a camera with a good quality lens and CCD image sensor will likely give you pleasing digital photographs.

The simplest digital cameras are point-and-shoot cameras -- simply aim them and push the button. They are very easy to use and are suitable for people who simply want to take family or vacation snapshots.

The downside to point-and-shoot cameras is the lack of control you have over focusing and image adjustment. As you go up the scale to more expensive cameras, you get more of these kinds of options.

The simplest point-and-shoot cameras often have a low megapixel rating -- around two megapixels.

Slightly better cameras in the three to five megapixel range usually also have more controls for focusing and image adjustment. Prosumer models are designed for those who are serious about photography but don't have the budget for professional equipment.

Professional digital cameras offer the greatest flexibility for capturing digital images. These cameras are the most expensive and can cost several thousand dollars.

You are presented with many choices when buying a digital camera. There are different types of image sensors, storage cards, batteries, as well as extra features like video and audio recording.

As mentioned in the previous article, image sensors and lenses are the most important parts of a digital camera for capturing quality images. They are not the only things to consider, though.

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Controls

Many of the controls on digital cameras are accessed through a menu system. An easy-to-use menu system is a great benefit to any digital photographer, so this is an important point to consider when shopping around.

The menu system should be clearly laid out so that you can access settings such as resolution, flash, and exposure settings. Too many buttons can be confusing and can inhibit the average user from accessing all the features.

Exposure Settings

Exposure settings allow you to adjust the camera for various types of light. Almost all digital cameras have an automatic mode which will do the adjusting for you, but better cameras will give you more control over aperture settings and exposure times.

These can give your photos a more professional look, but some people may not be interested in this level of control.

Video and Audio

Many digital cameras allow you to shoot videos and/or record sound.

These features can be handy, but the amount of video that can be captured is quite small compared to a dedicated camcorder.

LCD Display

LCD displays allow you to see pictures you have taken. This is essential for deciding which shots to keep and which to discard.

The display may also function as a viewfinder allowing you to see how your shot will look before you press the shutter button. Some of the cheapest digital cameras do not have an LCD display.

Software

Some cameras come bundled with image-editing software like Adobe Photoshop Elements or Ulead PhotoImpact.

Software is a great way to edit your photos before they are printed. Software packages can cost up to \$100 if bought separately so having it included with the camera is a serious buying consideration.

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Try Before You Buy

If possible, take a few pictures with a digital camera before you buy it. This will give you a feel for the controls and the ease of use.

- How does the camera feel?
- Is it solid or does it seem like a plastic toy?
- Is the LCD screen easy to view under various lighting conditions?

Giving the camera a tryout will answer these questions.

I hope this brief guide has answered many of your questions about buying and using your digital camera.

Thanks for reading,

Warmly,

Rocky Tapscott