About Digital Cameras

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March 1, 2015

1. Introduction

This document attempts to set out some of the things that you might want to consider when buying a digital camera. If you have owned digital cameras for years, then I don't think that you'll find anything new here.
I do mention a number of camera manufacturers and their products. There are almost certainly other makes and cameras that will do the same as the ones I mention. I have tried to keep to ones that I, or my friends, have actually owned.

2. Megapixels and all that

Bits of a camera

All digital cameras have a lot in common. They have a lens on the front that collects the light reflected from your subject. The lens focusses an image of your subject on the sensor inside the camera. (The sensor, the part with all the megapixels, is the most expensive single item in most cameras.) The sensor converts the image into electronic data. A miniature computer inside the camera converts the data from the sensor into a file on the camera's memory card. So far, so good. . . . This is all a bit like your eye. This also has a lens, a sensor (called the retina) and a computer (part of your brain). Unfortunately for photography, your eye is a lot smarter than any digital camera. The eye can cope with a much bigger range of brightness and colour than cameras or the gadgets that produce prints. So what? A photographic image *cannot* look exactly as your eye saw the scene. With a good camera, a bit of time between seeing the scene and seeing the print and a bit of trickery we can get close enough to fool most humans. The camera can, and does, lie and does so quite convincingly.

How many megapixels do you need?

Camera manufacturers like to suggest that "more equals better" when it comes to megapixels (a megapixel is one million pixels, but you knew that). And, *all other things being equal*, this is true. The problem is that 'all other things' are rarely equal.

Sometimes, cramming more pixels in means that each individual sensor pixel is smaller. Smaller sensor pixels either don't perform as well in a number of ways or they cost a lot more. If the pixels don't get smaller, then more pixels means a bigger sensor (and that costs more too).
You can make good quality prints up to A4 size with a six megapixel camera (not many cameras have that few these days). With a little software trickery, you can make bigger prints but visual quality will suffer a bit if you stick them right under your nose to look at them. (You can also make very poor prints from a 24 megapixel camera!)
So what? For a given number of megapixels, the camera with the physically largest sensor is likely to give the best results. The physical size of the sensor is usually in the camera specifications but you have to search for it, unlike the number of megapixels which is always in the large print!
For most compact cameras, the sensor size is buried in the 'specification' part of the manual or website. It is usually given by giving the diagonal of the sensor rectangle (a bit like television screen sizes). Unlike TV screens, the size is usually given as a weird fraction. For example, one Nikon compact quotes "1/1.7inches". For sizes given like this, 1/1.7 sensor is *larger* than one quoted as 1/2.3.
These are really weird sizes, nothing directly to do with the size of the sensor. They date from the days of the *vidicon* tube, a sort long, thin, tubular valve with a flat front that was used as a sensor in early video cameras. A 1" digital camera sensor is the size of the image that would fit on a 1" diameter vidicon tube. No, I don't have any idea what size that is, except that it is rather less than 1 inch diagonal.
For most dSLRs, the size is given simply as so many millimetres (mm) each way. A 'full-frame' sensor (Nikon call this an 'FX' sensor) matches a 35mm film negative at about 36×24mm. An APS-C sized sensor (Nikon's 'DX' sensor) is about 24×16mm. There are a few dSLRs which have half-size sensors about 18×12mm.
So that you can compare the two systems, an FX sensor is probably about 2" in the other system and a DX sensor is about 1.4".

Zooming

Many digital cameras have 'zoom' lenses. This means that the lens is adjustable so that the camera 'sees' more or less of the scene. This is a very handy feature because you can take landscape shots with a lot of the scene captured (*wide angle shots*) or shots in which objects some distance away fill the picture (*telephoto shots*).
What I'm talking about here is **optical** zoom which is done by the lens. Some cameras also have **digital** zoom. This is completely useless and works by throwing pixels away and using what are left as the whole picture. You can do a better job of that than most cameras by using editing software.

3. Types of camera

I'm mostly going to ignore specialist cameras except for a few remarks at the end. The main types of digital camera in use by amateurs (and a lot of professionals) are:

- Compact cameras sometimes known as 'point and shoot', though most cameras can be used that way.
- Bridge cameras. These are a sort of half-way house between compacts and the next sort.

- Digital single-lens reflex cameras (also called dSLRs or SLRs for short).
- Compact system cameras. These are like compact cameras but have interchangeable lenses and (usually) larger sensors.

These categories used to be quite separate but the boundaries between the first two are a bit blurred these days. The price ranges overlap quite a lot, too, though the cheapest available cameras are compacts and the most expensive are dSLRs.

Compact cameras

These are very convenient, many will slip easily into a small pocket or handbag. They are usually light. They can offer anything from 3 times to 12 times optical zoom and some have very good quality lenses. Most of these cameras use a type of memory card which is quite cheap. All the ones I have ever seen have a small flash built in.
There are some disadvantages which mostly arise from the sensors being rather small (though they vary). The range of brightness that they can cope with in a picture is limited. Also, you will often see coloured speckles in shadow areas of the picture. This is *noise* which all camera sensors produce but smaller ones often produce proportionately more. You will see less noise in scenes which are well lit.
Most compact cameras rely on the display at the back to allow you to compose your picture, so the display has to be active all the time. The display uses quite a bit of power, so battery life is often quite short; you need at least one spare battery if you are going out for the day. Some of the more upmarket compacts have an 'optical' viewfinder that you look through. If you have one of these you can turn the display off which does wonders for battery life.
Some compact cameras take quite a long time to start up when you switch them on, though they are getting much better. They also sometimes have quite a delay between pressing the button and actually taking the picture (this is called **shutter lag**).

Bridge cameras

These are usually larger and heavier than compact cameras, though they rarely weigh more than 300–400 grammes. Like compact cameras, they have a built-in flash.
These have a viewfinder that you can use at eye level as well as the display on the back. You can turn off the back display and the viewfinder uses a much smaller display which is not quite as bad at eating batteries.
The sensor is usually a bit larger than in a compact camera (less noise, better brightness range). A bigger sensor needs a bigger lens and that makes a big zoom range harder to make (and more expensive). In spite of this, zoom ranges of 24 times are available. A few in this category have even larger zoom ranges.
Most bridge cameras have a lot more possible adjustments and options than compacts although you can still leave everything to the camera by setting it to the most automatic program. The memory cards are as cheap as for compacts.
Start up times and shutter lag are mostly similar to compacts.

Single-lens reflex cameras

These are larger (and mostly heavier) than the two previous types though there are some lightweight 'entry level' ones that weigh little more than some bridge cameras.
There are several very significant differences from the other two categories.

- Most give you a view through the lens directly (not using a display). If you keep use of the rear display to a minimum, this helps battery life a lot.
- You can change the lenses. For high-quality work this means that you can pick a lens suited to a particular type of photograph, if necessary. Most manufacturers make some special-purpose lenses for things like photographing architecture, though they are *very* expensive.
- The sensors are larger than for most of the other cameras. The common types of sensor are either about two-thirds of the dimensions of a 35mm film negative or the same size as one. A couple of manufacturers make a 'half size' sensor, but that is uncommon. The larger sensors bring benefits of less noise and greater brightness range.
- It is possible to set up the camera to suit the individual photographer, especially with the more expensive ones.
- Battery life is usually quite good. this is partly because there is no need to use a display and partly because they come fitted with high-capacity batteries.
- If you have used a film SLR and still have the lenses, it *may* be possible to use those lenses on a dSLR of the same make.
- Start up time and shutter lag are very much shorter than compact cameras.

As you might expect, these advantages do not come for free!

- Most dSLRs cost much more than a simple compact camera.
- The larger sensors require larger lenses which cost more to make, especially if they are zoom lenses. A lens with a wide zoom range usually has to be a bit of a compromise (or so expensive that you would need a mortgage).
- The memory cards are sometimes (not always) a bit more expensive and you may need more (and larger capacity) ones for reasons that I'll look at later.
- Some do not have a flash unit built in. That means more expense as most people do take flash photos some of the time. Fortunately, more manufacturers are ignoring photo 'snobs' who think that real dSLRs don't have built-in flash and more do now have them.
- The more robust, metal-bodied dSLRs do weigh quite a lot. Mine with a modest lens on the front weighs well over a kilogramme.

- Additional lenses also weigh quite a lot because they have a lot of glass in them.
- Spare batteries from the manufacturer are expensive (too expensive). Fortunately, there are *reliable* alternative sources of most batteries. (The camera manufacturers rarely make the batteries, just put their labels on them.)

Compact System Cameras

Several manufacturers are making slightly oversize compact cameras with sensors like those in dSLRs and also the ability to change lenses.They may rely on a rear display for composition or may have an eye-level viewfinder, usually electronic but occasionally optical.
These cameras have most of the advantages and disadvantages of dSLRs except that they are rather smaller and lighter (but not necessarily cheaper) than a mid-range dSLR.

Other types

there are also 'medium format' dSLR cameras which are used by some professionals and a very few, very wealthy amateurs. Typically, such cameras start at around £6000 and go on upwards (a long way upwards). They have very large sensors, big, heavy lenses and lots of megapixels. In the right hands they produce superb results. If you are in the market for one of these, you don't need to read this document. If you want to experiment, it is possible to hire such cameras.
Finally, there are very specialised cameras such as ones designed specially to fit telescopes. They can be quite exotic with cooling systems to stop very long exposures being plagued by noise.

4. Memory cards

There are various types of memory card that have been used since digital cameras first appeared but only a few are in common use now.

- Secure digital (SD) cards and their high capacity versions (SDHC, SDXC). Very, very common for compacts and many bridge cameras. Also used by some dSLRs. Very cheap for any given capacity and very widely available.
- Memory Stick (MS) and Memory Stick Pro (MSPro), these are trademarks of Sony Corporation. As far as I know, only Sony cameras use these. A bit more expensive for a given capacity than SD and SDHC cards. Although Sony dSLRs (mostly) take these, at least some of them can also take Compact Flash cards or SD/SDHC cards.
- Compact Flash (CF) cards are almost universal amongst professional and semi-professional dSLRs and quite a few nearer entry-level as well. Not quite as cheap as SD/SDHC cards but usually a bit cheaper than MS/MSPro. It gets a bit complicated because CF cards are available in various 'speeds'. High speed cards, used by photographers who shoot a lot of pictures in quick succession, cost more.
- XQD cards were supposed to be the successor to CF cards for professional and semi-professional dSLRs.

At the time of writing, they are used in only one Nikon camera. There has been a marked reluctance, so far, on the part of memory card makers to produce XQD cards. They are expensive, can have very large capacities and can accept data at very fast rates.

- The xD card, originally made just by Fujifilm, seems to be dying out. The SDHC card appears to be replacing it.

5. Batteries

A warning: here I'm going to expose some personal prejudice, based on bitter experience!
Ordinary non-rechargeable 'alkaline' batteries, or even high-capacity Duracell (tm) batteries are strictly for emergency use and very few cameras apart from entry-level compacts can use them.
Rechargeable versions of ordinary batteries (usually marked NiMH for nickel-metal hydride) are quite common in cheaper compact cameras. A few bridge cameras have also used them in the past. Any camera that relies on a display panel consumes battery power like there is no tomorrow and time between recharges is often disappointingly short. The one advantage is that they can be charged very rapidly with suitable chargers, though not with the chargers that come with cameras. NiMH batteries are quite heavy for a given power capacity.
The other type of rechargeable battery in common use is the lithium-ion (li-ion for short) battery. These are much lighter than a NiMH battery of the same capacity. They have dropped a lot in price recently (they are universal in mobile phones) but camera manufacturers charge far too much for ones with their label on. They cannot be charged very quickly; a full charge takes around 2 hours in the proper charger. A spare battery is almost essential. Most cameras have a warning when the battery is nearing the end of its charge. It pays to swap then and recharge. Li-ion batteries don't suffer if recharged when only partly discharged.
I don't think that any current model of dSLR takes NiMH batteries, they all seem to use li-ion ones.
From personal experience, I would only buy a camera that used li-ion batteries (until something better comes along). That 'something better' might turn out to be lithium-polymer batteries, li-poly for short.

6. The Pictures on the Card

Some time ago, the Joint Photographic Experts group (JPEG for short) invented a standard way of storing a photograph in a computer file. Such files are called JPEG ('jay-peg') files after the group.
A JPEG file cleverly stores a lot of image data in quite a small file. At the time the JPEG system was invented, this mattered because camera memory cards were small and very expensive. Unfortunately, converting the information from the sensor to a JPEG file throws away some information which is then lost forever.
If all you do is take the camera card to a high street photo printer, or show the photos on a computer or TV, this may not matter. If you do anything else (editing etc) then you have to be very careful or you may lose more image data. (That's a topic for another document.)
All known amateur and most professional digital cameras can store pictures as JPEG files. (A few medium format cameras can't do so.)

Quite a few of the more expensive compacts and just about all dSLRs can also store files as 'raw' data. This means that the information from the sensor is stored on the card, with nothing being discarded. A raw image file also contains a lot of information about the camera settings and other stuff that makes working with the image easier.
The downside to raw files is that you *must* do something with them on your computer before you can show them to others or get them printed in the high street. Also, they are much bigger files than a JPEG from the same image. (Often a raw file will be three times the size of the corresponding JPEG.)
It is worth seeing if the camera you want to buy can do raw files, even if you don't use the facility to begin with. You'll have more flexibility later when you get more adventurous.

7. Getting information

It is worth doing quite a lot of online research about any camera that you are thinking of buying. There are a number of websites that specialise in reviews submitted by users. I wouldn't take any single review as being totally reliable because every user has quite specific needs. Often you can get a good overall picture (sorry!) by looking at a number of reviews.