

Introduction to Photography

Topic 9 - Sensors Within

Learning Outcomes

In this topic, we will take a closer look at sensor sizes in digital cameras. By the end of this video you will have a better understanding of what the various sensor sizes mean and what suits you should you decide to purchase your own camera.

What is a sensor?

Nowadays, every digital camera is cored with a solid-state device which works like film cameras do, in that it captures light coming in through the lens to produce an image. This device is called a sensor.

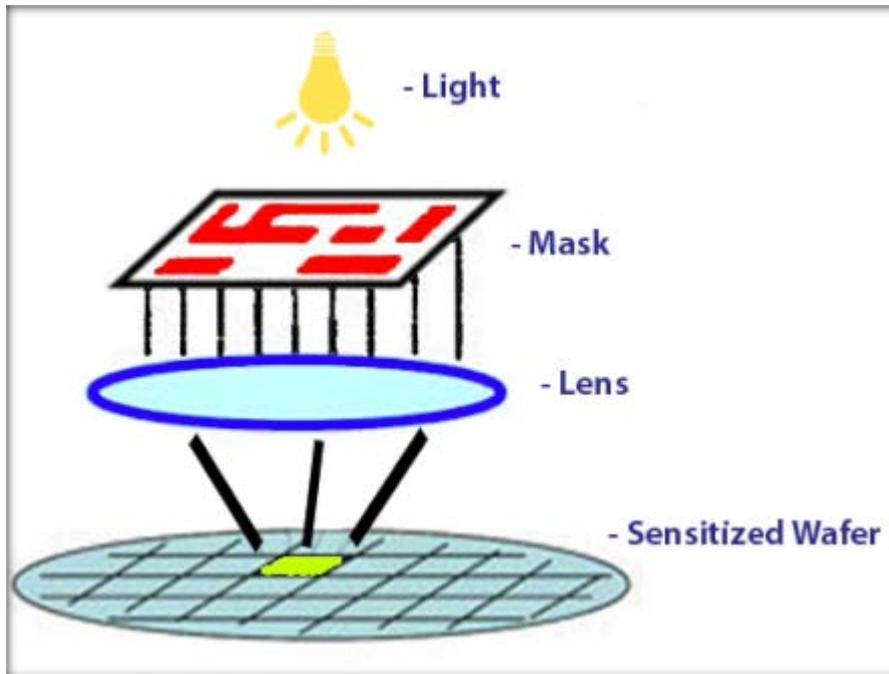
Photographer's Choice									
Sensor Name	Medium Format	Full Frame	APS-H	APS-C	4/3	1"	1/1.63"	1/2.3"	1/3.2"
Sensor Size	53.7 x 40.2mm	36 x 23.9mm	27.5x18.6mm	23.6x15.8mm	17.3x13mm	13.2x8.8mm	8.38x5.59mm	6.16x4.62mm	4.54x3.42mm
Sensor Area	21.59 cm ²	8.6 cm ²	5.19 cm ²	3.73 cm ²	2.25 cm ²	1.16 cm ²	0.47 cm ²	0.28 cm ²	0.15 cm ²
Crop Factor	0.64	1.0	1.29	1.52	2.0	2.7	4.3	5.62	7.61
Image									
Example									

The evolution of digital technology has meant that there are different sensor types and sizes available on the market today. When buying a new camera, one should always examine the sensor size.



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Photolithography



A sensor is a device created by using wafers of silicon that are used as the base for the circuit. Why Silicon? Well, when light hits it, you get electrons. They are then built up by a process known as photolithography.

Pixels are very important in digital photography and this process creates millions of tiny pixels. In each pixel, there is a light sensitive element which can sense how many photons have arrived at that particular location. As the charge output from each location is proportional to the intensity of light falling onto it, it becomes possible to reproduce the scene as the photographer originally saw it.

As well as being an analogue device, a sensor is also colour blind. In order for the sensor to sense different colours, a mosaic of coloured filters is placed over it, with twice as many green filters as there are of red and blue, to match the heightened sensitivity of the human eye towards the colour green. As some of you might already know, this means that each pixel only receives colour information for either red, green or blue – as such, the values for the other two colours must be guessed by a process known as demosaicing.



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More pixels can mean more detail, but the size of the sensor is vital for this to hold true. Smaller pixels are less efficient than larger ones. The two main attributes which separate images from compact cameras with small sensors and those from higher end DSLRs with large sensors, are dynamic range and noise. With DSLR with large sensors, pixels can be made larger and they can hold more light in relation to the noise created by the sensor through its operation, and thus, a cleaner image is produced.

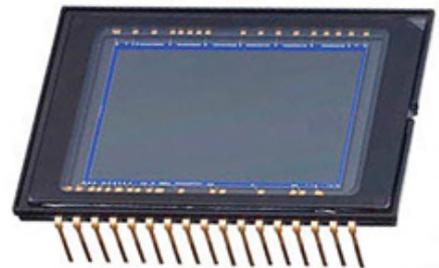
Noise Reduction Technology

Noise reduction technology, used in most cameras, aims to cover up any noise which has formed in the image, but this is usually only attainable by compromising its detail. This is standard on basic cameras and usually cannot be deactivated, unlike on some advanced cameras where the option to do so is provided (meaning you can take more care to process it out later yourself).

Types of Sensor

CCD sensor (Charge-Coupled Device)

Used for a number of years in video and stills cameras, CCDs offered superior image quality to CMOS sensors, with better dynamic range and noise control.

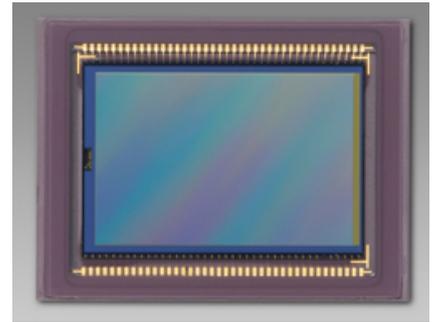


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CMOS sensor (Complementary Metal-Oxide-Semiconductor)

Long seen as an inferior competitor to the CCD, CMOS sensors have progressed to match or better the CCD standard.

With more functionality built on-chip than CCDs, CMOS sensors are able to work more efficiently and require less power to do so, and are better suited to high-speed capture.

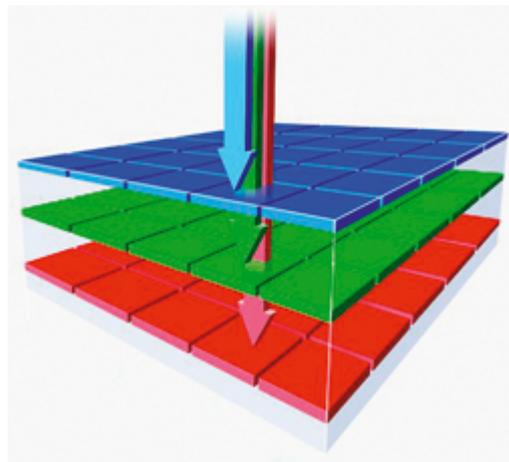


Foveon X3 sensor

Foveon X3 is based on CMOS technology and is used in Sigma's compact cameras and DSLRs.

The Foveon X3 system rejects the Bayer filter array, and opts for three layers of silicon in its place.

Without bogging you down in too much detail about various sensor sizes, let us look at what is quickly becoming the standard for photographers.



Full Frame – 36 x 24mm

Full Frame which is 36 x 24mm is the largest sensor size found in 35mm DSLRs. It shares its dimensions with a frame of 35mm negative film, and so applies no crop factor to lenses. It used to be the reserve of very high-end cameras, for professionals only, but the technology is getting more affordable. Some camera models with Full Frame Sensor include: Canon EOS 5D Mark III, Canon EOS 6D, Nikon D5, and the Nikon D810.



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What have we learned today? A Summary

We've learned about pixels and how important they are in digital photography.

We've also learned that there are three main sensor types: CCD, CMOS and the Foveon X3

