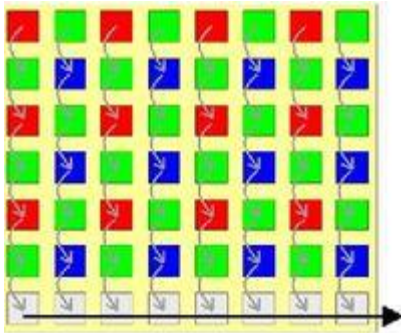


DIFFERENCE BETWEEN CCD AND CMOS

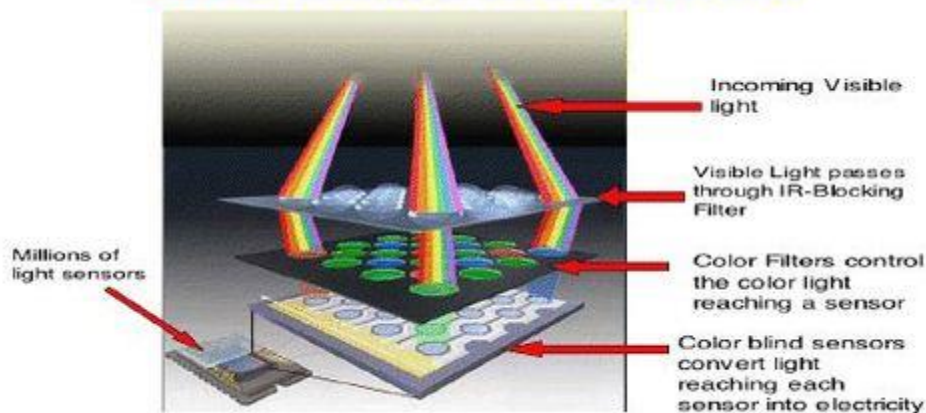
CCD chips and CMOS chips are the two types of image sensors that are used in Digital cameras. Both the image sensors were invented in the late 1960s and 1970s. CCD became leading just because they gave far better image quality with the fabrication technology available on the other hand CMOS image sensors required more consistency and smaller features than silicon wafer could deliver at the time.

In CCD (Charge coupled device) digital imaging, when the light waves enter the camera they focus on the sensor that converts light into the electrical charge and the image is formed. It is simple: the more light that hits the photodiode, the greater is the charge. But how does this process separate the colors? The light entering the camera is the normal white light that contains all the wavelengths, so inside the mechanism these wavelengths are separated by filters that are based on the basic RGB (red-green-blue) principle. The information is read row by row and pixel by pixel, therefore, the necessary processing time is a bit longer, but it is very accurate.



A CMOS (Complementary Metal Oxide Semiconductor) sensor, instead of converting the light wave into an electrical charge on a different chip, it converts the photons into electrons by processing the data at this point (and not on another chip). By using amplifiers, these sensors are faster than CCDs.

RGB Inside the Camera



DIFFERENCES

Responsivity: It is the amount of signal that the sensor can deliver per unit of input optical energy. The CMOS imagers are slightly more superior to CCDs because it is easier to place gain elements on CMOS sensor because the transistors allow low- power high- gain amplifiers whereas in CCD the amplification generally comes at a cost of power consumption.

Uniformity: It is the stability of response for different pixels under equal clarification conditions. It is important to differentiate between uniformity under illumination and regularity near dark. CMOS imagers were usually much worse under both conditions. As each pixel has an open loop output amplifier and the offset and gain varies noticeably making both dark and light non uniformities than those in CCDs.

Shuttering: It is the ability to start and stop contact randomly. CCDs can deliver better electronic shuttering with little fill-factor cooperate, even in small-pixel image sensors as compared to CMOS. As to implement uniform electronic shuttering in CMOS imagers require a number of transistors in each pixel. To overcome this drawback a non uniform shutter called the rolling shutter is used which exposes different lines of an array at different times due to which the number of in-pixel transistor is reduced which improves the fill factor. This may be sometimes helpful at the cost of customer but when high performance rate is required it is not the better

option as the motion of the object is visible.

Speed: It is the place where CMOS imager has a better advantage over CCDs because all the camera functions in CMOS can be placed on image sensor. With a single die, signal and power trace distances can be shorter with less capacitance, inductance and propagation delays.

Windowing: One of the distinct ability of CMOS technology is the ability to read out a portion of the image sensor as this allows the important frame or line rates for small region of interest also to be read. CCDs usually have limited capabilities in windowing.

Antiblooming: It is the ability to gracefully consume restricted overexposure without cooperating with the rest of the image in the sensor. CMOS generally have this ability while CCDs on the other hand require some specific engineering to achieve this task.

Reliability: Both the image sensors are equally reliable in most of the consumer and industrial applications. Then too CMOS imagers have advantage because all the circuit can be placed on the single chip which minimizes the leads and solder joints. This means that CMOS based cameras can be considerably smaller in size as compared to CCD based cameras.

Cost: The CMOS may be less expensive at the system level as compared to CCDs when the cost of the circuit functions like timing generation, biasing, analog signal processing, digitization and feedback circuit are considered. But it is not cheaper at the component level for the pure image sensor function itself.

For a moment both the technologies remain complementary to each other as one can do the things uniquely that the other cannot do. But in the coming future CMOS technology will start consuming more and more applications of CCDs.

Canon Inc. announced that it has successfully developed an APS-H-size*1 CMOS image sensor

that delivers an image resolution of approximately 120 megapixels (13,280 x 9,184 pixels), the world's highest level*2 of resolution for its size.

Source : <http://www.udaipurTalents.com/technical-learning/difference-between-ccd-and-cmos>