Digital Cameras

INF-MKT presentation
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Introduction

- A conventional camera uses film to capture images.
- In a digital camera film has been replaced with a semiconductor device that records light electronically.
- Apart from this the two types of camera operate in the same manner.
Image sensors

- The task of an image sensor is to convert light into electrical charges.
- The sensor has a collection of light-sensitive diodes called photosites.
- Each photosite is sensitive to light – the brighter the light that hits a single photosite is, the greater the electrical charge that will accumulate at that site will be.

Image sensors

- There are two types of image sensors commonly used in digital cameras:
  - Charge Coupled Device (CCD)
  - Complementary Metal Oxide Semiconductor (CMOS)
- These two sensor types have much in common, both can be thought of as a two-dimensional array of photosites.
CCD vs CMOS

- CCD creates high-quality low noise images, while CMOS is more susceptible to noise.
- CCDs are more light sensitive than CMOS sensors.
- CCD sensors consume about 100 times more power than CMOS sensors.
- CCD sensors require a special manufacturing process, while CMOS chips can be made using a standard silicon production line.
- CMOS sensors are cheaper than CCD sensors.

CCD vs CMOS

- CMOS is used in low end cameras.
- CCDs are used in most digital cameras on the market today.
How an image sensor works

- The image sensor has a two-dimensional array of thousands or millions of photosites, each of which transforms light from one small portion of the image into electrical charges.
- An analog to digital converter (ADC) reads the charge of each photosite and converts it into a digital value.

Photosites are colour blind

- A photosite keeps track of the total intensity of the light that strikes its surface.
- Filtering is necessary to make a full colour image.
- Filtering works by recording different values for three primary colours of light, in most cases red, green and blue are used.
Filtering – beam splitting

- Light entering the camera is split into three identical beams.
- Each beam hits a separate CCD with a filter in front of it.
- Each of the three colours is recorded at each pixel location.
- This method is used in the highest quality cameras, which become bulky and expensive because three CCDs are needed.

Filtering – spinning disk

- A series of red, blue and green filters are rotated in front of a single CCD.
- The sensor records three separate images in rapid succession.
- The camera must remain stationary for all three readings, rendering this method virtually unusable for handheld cameras.
Filtering

- An economical and practical way to record the colours is to place a filter over each photosite.
- Dividing the sensor into red, blue and green gives enough information in the vicinity of each photosite to make very accurate guesses about the true colour at that location.
- This process is called interpolation.

Colour sensitivity of the eye

- The human eye perceives green colour better than others.
- A picture will be considered a poor representation of reality if there are inaccuracies in the green spectrum.
Filtering - Bayer

- The most used filter is the Bayer filter.
- There is twice as much green as there is red or blue, due to the way the human eye perceives colour.
- Only one sensor is required, and all the colour information is recorded at the same moment.

Photosites vs Pixels

- There are more photosites than pixels.
- A pixel corresponds to one photosite.
- The excess photosites are dyed black to compensate for the "dark current"-effect.
- "Dark current" is current formed despite no exposure to light.
Picture formats

- The two main file formats used by digital cameras are TIFF and JPEG.
- Most cameras use JPEG and offer different quality settings (i.e., different rates of compression).
- Some high-end cameras can also save the raw sensor data, the format called RAW.

Resolution and compression

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<th>JPG (1:15)</th>
<th>TIFF</th>
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## Printing on paper

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</table>

## Storage

- CompactFlash
- SmartMedia
- Memory Stick
- Secure Digital Card
- xD picture card
- MicroDrive
- CD-R/floppy disk
Literature

- http://www.akam.no/guider/
- http://www.xd.no/
- http://www.komplett.no/
- http://www.genit.no/digitalkamera.htm
- http://www.japanphoto.no/