The Digital Video Camera

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Digital Video

- Digital Video
  - A video recording system that works by using a digital rather than an analog video signal

- Digital
  - A system that uses discrete (discontinuous) values to represent information for input, processing, transmission, storage, etc
  - In short - transmission of symbols

- Analog
  - A systems that uses a continuous range of values to represent information

Basic Video Camera

- Camera
  - A device used to capture images, either as still photographs or as sequences of moving images (movies or videos)
  - Come from - camera obscura (Latin for “dark chamber”)
Basic Video Camera

- All cameras "transduce" or translate the optical image that the lens sees to a corresponding video picture.
- In the digital video camera, the image is converted into the electrical signals that are reconverted by a television receiver into visible screen images.
- This creates the broadcast system.

The Broadcast System

- Goals:
  - Efficient use of bandwidth
  - High viewer perception of quality

Basic Video Camera

- Three main functions:
  - The lens
  - The Imaging Device
  - The Viewfinder
### The lens
- **Lens** - determines what the camera can see
  - Classified by focal length - the technical measure of the distance from the iris inside the lens to the plane where the projected image is in focus.
    - This distance is normal given in millimeters (mm).
- **Wide angle** = short focal length
- **Narrow angle** = long focal length
- **Speed** = how much light a lens lets through
  - **Slow** = little light
  - **Fast** = more light
- **Optical quality generally determines how good the picture will look through the lens.**

### The lens
- **Focus** - also called an image point – this is the point where light rays originating from a point on the object converge.
- Moving focus is called “pulling” or “racking” focus.
- An image is focused if light from object points is converged almost as much as possible in the image, and out of focus if light is not well converged.
- A lens can precisely focus at only one distance.
  - The decrease in sharpness is gradual on either side of the focused distance, so that within the Depth of Field.

### The lens
- **Zoom lens** – can change focal length from short or wide angle to long or narrow angle and back in one continuous move.
The lens

- Zoom range – also known as zoom ratio is how close of
  and image you can achieve between the widest and
  tightest views – adjusts focal length
  - A 20:1 lens for example will give you a 20x closer view when
    zoomed in vs zoomed out
  - As a non-adjustable zoom it is a “prime” lens

- Digital zoom – the center of the image is gradually
  magnified, it becomes less sharp and eventually
  pixilates the image
  - Try not to use this feature
  - Do not confuse with optical zoom

- Aperture – or iris is like the pupil in the human eye
  - Controls the amount of light allowed to pass through
    the opening
  - Also known as lens diaphragm
  - Amount of light expressed as an f-stop
  - Open lens equals a low f-stop number such as a 1.4
  - A closed lens equals a high f-stop number such as a 22
    or a measure of being “stopped down”
F-stop
- The iris ring of most lenses are marked with a series of numbers with a ratio of 1:1.4, 1.7, 2, 2.8, 3.5, 4, 5.6, 8, 11, 16, 22 (the focal ratio)
  - The brightness of the image is inversely proportion to the square of the F-number
  - Each time the ring is turned one number up the F scale, the brightness is decreased by half
  - As the iris ring is turned down one number, the brightness is increased by twice
- A smaller F-stop means a brighter image

The lens
- Auto Iris – adjust aperture automatically
  - Adjust for optimum setting of overall light level
  - Try to avoid using
  - Can create “breathing” effect

The imager
- These Devices change the optical image produced by the lens to a video signal
- Beam Splitter – divides the light that comes through the lens into red, green, and blue (RGB) light beams
The Imager

- Beam splitter

The imaging device – CCD or chip is known as a Charged Coupled Device.

- The imager is sometimes a CMOS chip now or Complementary metal–oxide–semiconductor.

- The imager transduces or encodes the light beams into electrical energy, which is processed into a video signal.

CCD - Digital color cameras generally use a Bayer mask over the CCD. Each square of four pixels has one filtered red, one blue, and two green (the human eye is more sensitive to green than either red or blue).

- Better color separation can be reached by three-CCD devices (3CCD) and a dichroic beam splitter prism, that splits the image into red, green and blue components.
The Viewfinder

- The viewfinder is a small video monitor attached to the camera that shows an image of what the camera sees.
- Often the viewfinder is black and white on professional cameras.
- Many cameras now come with a flip out LCD panel that can be used instead of the viewfinder:
  - Can be more convenient
  - Can also use much more battery power
- Also may choose to connect to an external monitor usually for a larger easier to monitor image.

Camera Types

- Include small and large cameras
- Portable cameras with recording device attached or built in

- High definition or HDV cameras, which, despite their small size produce high resolution images with high color fidelity
Camera Types

- Studio cameras, which with different lenses can be used in the field

Camera Types

- ENG = Electronic News Gathering or EFP = Electronic Field Production
  - High end shoulder mounted cameras for field use

Camera Types

- Electronic cinema cameras are HDTV cameras with certain attachment carried over from film
The studio camera chain consists of four parts:
- The camera head (the actual camera)
- The power supply
- The sync generator
- The camera control unit (CCU)

The camera head:
- The front part of the chain
- Cannot function by itself
- The camera itself

The Power Supply:
- Feeds electricity to the camera head through the camera cable
- Unlike field cameras, usually cannot be powered by battery
Camera Chain

- The sync generator – produces the uniform electrical pulse that is necessary to synchronize the scanning of the video pictures in all cameras used in a multi camera telecast.

- The camera Control unit (CCU) – two major functions:
  - Setup – the adjustments made when the camera is first powered up.
  - Control – during production makes sure that:
    - the colors are true
    - that the iris is at the proper setting
    - that the camera is adjusted for the brightest spot – white level
    - that the camera is adjusted for the darkest spot – black level
  - Usually run by the Video Operator (VO) or engineer.

Connectors

- The most widely used video connector is the BNC:
  - named after its bayonet mount locking mechanism and its two inventors, Paul Neill of Bell Labs (inventor of the N connector) and Amphenol engineer Carl Cancelman (inventor of the C connector), and is much smaller than both the N and the C connectors.
  - Other acronyms - the BNC has picked up over the years include: "Baby Neill-Cancelman", "Baby N connector", "British Naval Connector", "Bayonet Nut Connector"
Connectors

- S-video also common
  - also known as Y/C is an analog video signal that carries the video data as two separate signals, luma (luminance) and chroma (color), unlike composite video which carries picture information as a single lower-quality signal.

- RCA
  - referred to as a phono connector or CINCH/AV connector
  - a type of electrical connector that is commonly used in the audio/video market
  - "RCA" derives from the Radio Corporation of America, which introduced the design in the early 1940s to allow mono phonograph players to be connected to amplifiers
  - The word phono is an abbreviation of the word phonograph, because this connector was originally created to allow the connection of a phonograph turntable.
  - Low quality generally (consumer)

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