Introduction to the Digital Video Camera

The following is a collection of some of the features of a digital video camera. Since accessing these features will be different from camera to camera, I recommend reading the camera’s manual on how to do this. This handout concentrates more on the ways most functions of a camera work and what they do rather than how to access them (i.e. which button to press where). The short explanations of these terms should help you in your first experiments with the camera. The ETB area still has some older MiniDV–based cameras and a good selection of newer memory–card–based HD cameras. Read the definitions below carefully to know advantages and disadvantages of each of the types of video cameras. For example, some older models allow easy access to many manual settings but record at lower resolutions while newer HD models often hide manual settings in pre-defined scene modes and make them inaccessible.

HD, SD and image resolution:
The main difference between a SD (Standard Definition) and HD (High Definition) video camera is the resolution at which pictures are stored. While SD cameras record video images at a resolution of 720x480 (either 4:3 or 16:9) there are different resolutions at which HD cameras record their video images. The highest possible resolution is 1920x1080 (also sometimes called 1080i or 1080p – the “i” stands for interlaced, which means two half frames constitute one full frame, the “p” stands for the full frame option – we will talk more about this when we look at TV and video standards). HD cameras almost always record in the 16:9 aspect ratio.

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<th>HD frame, 1920x1080 pixels</th>
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<table>
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<tr>
<th>SD frame, 720x480 pixels</th>
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<td>(4:3, center) or 853x480 (16:9)</td>
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Please also see Electronic Arts Intermix’s extensive discussion/guide on high definition video at: [http://www.eai.org/webPage.htm?id=79](http://www.eai.org/webPage.htm?id=79).

While it is often believed that a higher resolution of the video images automatically results in a better quality, this is not always true. The quality (color, sharpness, levels) of
the actual image recorded depends largely on the camera’s lens and CCD (see next page). A good SD camera thus records better video images than a cheap HD camera.

CCD:
CCD means Charge–Coupled Device, a set of sensors that collect what the lens sees (the light coming through lens and iris). The CCD converts this image from the outside world into digital signals. Single chip digital cameras are equipped with only one such device (all colors are processed by only one chip). Three–chip cameras however possess one such chip for each prime color (additive color system): red green and blue. This results in an approximately 20 percent better image quality with regard to picture and color resolution.

Recording media: tape vs. memory card:
Older SD and HD cameras store recorded images and sound on MiniDV tapes while newer HD cameras store content on either memory cards or built in memory. There are pros and cons to each medium, tapes are prone to dropouts caused by specs of dust and dirt but very rarely fail completely. Memory cards can be misformatted or data can be damaged when reading them with devices other than the camera. Usually problems like this will render everything on the whole card illegible. Camera’s with built–in memory become useless once the built–in memory stops working (like an old harddrive). Important: when you use a camera with MiniDV tapes you must burn a time–code on the tape in order to avoid serious pitfalls during the transfer process onto the computer. Simply insert a blank tape and hit the record button (preferably with the lens cap on) and let the tape run until it reaches the end. If you use a camera that records onto a memory card format the card in the camera first before you start recording. You only need to do this once – be aware though that formatting a memory card will delete all of its content!

Before you record – check your camera settings:
MiniDV cameras allow you to switch between SP and LP MODE – Use SP or Standard Play only. For the Audio Sample Format use 16bit, not 12 bit. Our HD cameras have varying quality settings, I would recommend to always record at the highest quality setting (please consult the camera’s manual).

Lens and iris:
The lens of a video camera gathers and concentrates light that falls from objects, persons, spaces, etc. onto an image processing chip in the camera. Between the lens and the image processing chip is the iris, which regulates how much light falls onto the chip. In its function the lens and iris of a video camera can be compared with the human eye – the image processing chip being the retina. Sometimes the iris is also referred to as aperture. The opening and closing of the iris/aperture has an interesting effect on the video camera’s depth of field, too. An almost closed iris allows more objects at different distances to be in focus while with an almost fully opened iris only very few objects close together are in focus. However, depth of field is less pronounced in video than in film. It largely depends on the quality of the video camera’s lens. Choose the highest quality camera possible if you would like to work with this effect. The ideal aperture, or lens opening for general purpose recording is around f4/f5.6.

Shutter:
The shutter is a device that opens and closes rapidly in front of the camera’s lens. By increasing the speed of the shutter, faster movements are less blurry when recorded. However these faster shutter speeds also need more light. The normal shutter speed for video is 1/60 sec. You can increase the shutter speed in order to achieve a sharper picture. 1/30 sec tends to produce video “trails” while 1/200 sec may cause “fits” in your video.
Gain:
To make the camera more sensitive to the incoming light adjust the gain. You use it when the scene has insufficient light (at night) It is better to light a scene since what you are doing is amplifying the signal which also increases the amount of “noise” or grain in the picture which you want to avoid.

Focus:
Good digital video cameras allow you to change the focus manually with a focus ring (often around the lens). Depending on the aperture it allows you to only focus on very few objects close together or a wide range of objects far apart from each other (depth of field). The best way to manually focus on a scene is to zoom in as far as possible to the center of your scene, focus on it and then zoom out again, this will ensure that all of the content in your frame is well focused.

Zoom:
Digital video cameras offer optical zoom (through the lens) and digital zoom. The digital zoom works by increasing the number of pixels of an image without increasing the information that is held by each pixel. The image appears to be bigger but at the same it gets blurry and/or pixilated. This doesn't happen with the optical zoom, which uses optical techniques to view objects bigger. The digital zoom only sets in when the optical zoom is maxed out. Usually, if you press the zoom button harder the zoom will go faster, and the less pressure you use the slower the more gradual the zoom.

White Balance:
Only the human eye adapts rapidly to changing light conditions and changing "temperatures" of light, Neon light has a different temperature than candlelight. The first being rather blue, the second one rather red. The human brain adapts colors to these changing light conditions on the fly, not so the video camera. The white balance function allows you to calibrate the video camera for certain light temperatures (e.g. filming in natural light and then filming inside with neon lights). This calibration process is done on a white surface as a reference. Hold a white sheet of paper in front of the camera’s lens (filling the frame as much as possible) so that the light illuminating your scene falls onto the white sheet of paper, now press the manual white balance button and observe how the color temperature of your video image changes.

Mixing Daylight and Incandescent Light:
Often when shooting inside you may need to mix daylight with incandescent light. For example, if you are shooting in a room with a window. If the window does not illuminate your subject sufficiently or is unflattering, you may use a light from a light kit to boost the illumination to an appropriate level. When mixing indoor and outdoor lights, you may put a blue gel over the lamp to match the qualities of light. Regardless, you must white balance your camera as if you where shooting in daylight.

Lighting:
A video camera cannot handle contrasts very well. Video has a contrast ratio of 20:1. That means that the darkest part of your picture cannot be more then 20 times darker then the lightest part, otherwise tones will not reproduce correctly. Hot spots will glow and distort and darker spots will look black and grainy. The human eye can handle a contrast ration of 100:1 and film is 40:1. What looks good to the eye often looks terrible on video.

Most cameras have automatic aperture. It takes an average reading of the quality of light for an entire scene and adjusts the aperture based on that average. Avoid heavily backlit subjects. Conversely, try to avoid black backgrounds. The camera will open up the aperture to compensate for the black background and skin tones will be washed out and
distorted. In both circumstances, zoom in all the way and set the aperture and shutter speed accordingly.

For outdoor shots, first check to see where the light is. Do not shoot directly into the sun/a background light or your subject will be too dark. Conversely, watch that direct hard sunlight does not wash out your subject’s features.

Some of the above mentioned functions of the video camera have a “right way” of being used – for example in more traditional film/video practice. However, being aware of the right way of using a piece of technology also enables you to knowingly work against it and deliberately using it in alternative ways. This use of technology against its originally intended purpose has often been at the core of artistic explorations of new technologies and I invite you to try it out yourself. Think about the many different ideas that can be communicated by e.g. video shoot completely out of focus, deliberately setting the white balance to a color other than white, mixing daylight and artificial light or exploring the aesthetics of the artifacts created with a maxed out digital zoom.

**Historical comparison between film and video media in the context of video art**

These distinctions are becoming somewhat blurred though with the rapid development of digital A/V recording and playback technologies. Nevertheless this table introduces some crucial distinctions between the media that are important to be aware of when looking at the historical development of video art:

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<th>Film</th>
<th>Video</th>
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<tr>
<td>Used since:</td>
<td>Late 19th century</td>
<td>1950s</td>
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<tr>
<td>Recording format:</td>
<td>Still images on photographic film</td>
<td>Electronic data on magnetized tape</td>
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<tr>
<td>Recording speed:</td>
<td>24 frames per second</td>
<td>25, 29.97 frames per second</td>
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<td>Accessibility for artists:</td>
<td>difficult</td>
<td>relatively easy</td>
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<tr>
<td>Cost:</td>
<td>expensive</td>
<td>cheap</td>
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<tr>
<td>Quality:</td>
<td>high</td>
<td>low</td>
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<tr>
<td>Processing of visual material:</td>
<td>needs to be developed (long timeframe), time-consuming to modify</td>
<td>recorded in realtime, possibility of realtime playback and modification – immediate.</td>
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<tr>
<td>Early distribution:</td>
<td>studio-based</td>
<td>community-based, individual</td>
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Remember, this is a historical comparison. In recent years these differences have been almost completely eliminated due to the increasing quality of digital recording and storage devices (e.g. DSLR cameras that can shoot moving images, HD video, etc...).
Accessories

Tripod:
Use it whenever necessary! Hand Held Operation: If you choose to shoot handheld, remember that when you are zoomed in all the way in, the camera shakes and jiggles are magnified intensely. ETB has a few video tripods for you to check out. Please also check the VPA service desk in the basement of Pao Hall next to our computer lab (B179) for tripods as well as the undergraduate library (HICKS). Sometimes, depending on your scene and location you can also use a stack of books or other objects as improvised tripods.

External microphones and headphones:
If sound is important to your video recording it is essential that you wear headsets and listen carefully. Position your subject to avoid distracting background noises. Try to have your microphone pointed away from sources of noise—traffic, air-conditioning, fans, refrigerators.
The built-in microphones are very limited and are really only for picking up ambient sounds. They are nearly useless for recording speech. To set your recording level, record someone speaking loudly nearby. Increase the manual sound level (audio gain) as much as you can without causing distortion. Sound levels greater than 0dB will be distorted.

Omnidirectional microphone: coverage in all directions (ambient sound)

Cardioid microphone: heart-shaped pick-up pattern. Optimized to pick up sound directly in front of it with some sensitivity to either side.

Shotgun microphone: Directionally sensitive, captures what you point at and minimizes sound from other sources

Later on during the editing of the videos on the computers in the lab it is absolutely necessary to bring your own headphones!
Cables:

RCA
female  male

S-VHS
male

BNC
male  female

Y  Pb  Pr
Component Video

Y: brightness/luma
Pb color difference signal B−Y / chroma
Pr: color difference signal R−Y / chroma
Audio 1/8”
(miniplug)  male  female

Audio 1/4”
male

XLR
(professional Audio)  male  female

Firewire
male

USB
male  Type A  Type B

10  5  1  6
Female

VGA / XGA
Video Graphics Array / Extended Graphics Array

DVI-D Receptacle Connector

DVI
Digital Visual Interface
HDMI (High-Definition Multimedia Interface)