BASICS OF VIDEO

Introduction

The world of digital video (DV) includes a large amount of technology. There are whole industries focused on the tones of professional video, including cameras, storage, and transmission. But you do not need to feel intimidated. As DV technology has developed, it has become increasingly easier to produce high-quality work with a minimum of fundamental technical knowledge.

One of the first things you should understand when talking about video or audio is the difference between analog and digital.

Analog: An **analog** signal is a continuously changeable voltage that comes into sight as a waveform when plotted over time. Each vertical line in Figures 1a and 1b, for example, could represent 1/10,000 of a second. If the minimum voltage in the waveform is 0 and the maximum is 1, point A would be about .25 volts (Figure 1a).

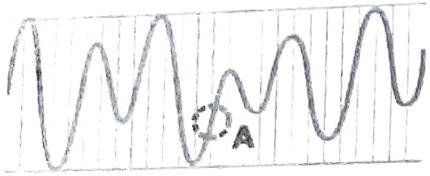


Figure1a Analog signal

1b Digital signal

Digital: A **digital** signal, on the other hand, is a numerical representation of an analog signal. A digital signal is actually a stream of bits (a long list of binary numbers). Each number in the list is a snapshot, or sample, of the analog signal at a point in time (Figure 1b). The **sample rate** of a digital stream is the number of snapshots per second. For example, if 0 volts is represented by the numerical value 0 and 1 volt by the value 256, point "A" would be represented by the number 64, which in binary form is a string of ones and zeros like this: 1000000

Digital has a number of advantages over analog. One of the most important is the very high *reliability* of the content. An analog device, like a cassette recorder or television set, simply renders the variations in voltage as sound or pictures, and has no way of distinguishing between a voltage variation that comes from the original signal and one that comes from electrical interference caused by a power line, for example (Figure 2a). Electrical interference or noise can come from an external source or from the tape, or components in a recorder or the television itself. When you duplicate a tape, noise recorded on the original tape is added to the new tape. If you were to then duplicate the new tape, noise from the two previous tapes would be added to the third tape and so on. Each copy of the tape adds to the **generation loss**, or loss in fidelity (*reliability*), from the original.

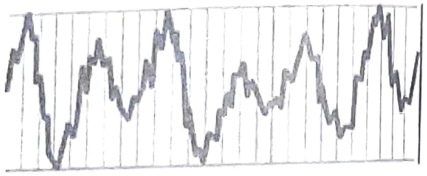


Figure 2a Analog signal with noise from systems electronics or recording tape

Figure 2b Digital (binary) signal with noise

With digital, the signal recorded on a tape or sent through the air consists of nothing more than a string of one and zeroes that a digital player converts to numbers and then to sounds or pictures. Since a digital player only reads one and zeroes, it can more easily distinguish between the original signal and noise (Figure 2b). So a digital signal can be transmitted and duplicated as often as you want with no (or very little) loss in fidelity (*reliability*).

Frame rates and fields:

When a series of sequential pictures is shown in fast succession, a remarkable thing happens. Instead of seeing each image separately, we distinguish a smoothly moving animation. This is the foundation for film and video. *The number of pictures shown per second is called the frame rate.* It takes a minimum frame rate of about 10 frames per second (*fps*) for the viewer to distinguish smooth motion. Below that speed, a person can distinguish the individual still images and motion appears jerky. To keep away from that flicker between frames, you require a frame rate of between 30 and 45 fps. Film has a frame rate of 24 fps. Television has a frame rate of just about 30 fps (29.97 fps) in the U.S. and other countries that use the *National Television Systems Committee* (NTSC) standard, and roughly 25 fps in countries that use the *Phase-Alternating Line* (PAL) and *Sequential Color Avec Memoire* (SECAM) standards.

There are two ways that a frame can be presented to an observer:

1. **progressively (Non-interlaced)**
2. **Interlaced scanning.**

Through film, the shutter in a projector shows each frame in its entirety, and then displays the next frame. This *progressive (Non-interlace)* method of displaying complete frames is similar to the way in which a computer display is refreshed. A whole new image is scanned about 60 times a second. Digital television sets are as well capable of progressive display.

Interlaced scanning was developed in the early days of television to accommodate the old *cathode* ray tube (CRT). Inside the tube, an electron beam scans across the inside of the screen, which includes a light-emitting phosphor coating. Unlike the phosphors used in today's computer monitors, those used when televisions were first invented had a very short *persistence*. That means the amount of time they could remain illuminated was *short*. In the time it took the electron beam to scan to the bottom of the screen, the phosphors at the top were already going dark. To solve this problem, the early television engineers designed an interlaced system for scanning the electron beam. With an interlaced system, the beam only scans the odd-numbered lines the first time, and then returns to the top and scans the even-numbered lines. These two alternating sets of lines are known as the upper (or odd) and lower (or even) **fields** in the television signal. A television that displays 30 frames per second is really displaying 60 fields per second—two interlaced images per frame.

Various Video Effects:

The basic effects that are supported by AVS Video Editor are divided into following four (4) groups:

1. **Adjust**
2. **Effect**
3. **Transform**
4. **Draw**

Adjust : The **Adjust** effects of the permit us to introduce various color, tone, brightness and similar adjustments to our media file.

Name of Effect	Function
Brightness	Opens **Brightness** effect to make simple adjustments to the tonal range of a file
Brightness Ex	Opens **Brightness Ex** effect to make simple adjustments to the tonal range in a color you choose
Contrast	Opens **Contrast** effect to adjust the contrast of an image
Auto Contrast	Opens **Auto Contrast** command to adjust the overall contrast and mixture of colors in an RGB image automatically
Auto Levels	Opens **Auto Levels** effect which defines the lightest and darkest pixels in each color channel as white and black and then redistributes intermediate pixel values proportionately
Gamma	Opens **Gamma** effect to measure the brightness of midtone values and modify the pixel values in an image
Equalize	Opens **Equalize** effect to normalize the histogram of a file
Invert	Opens **Invert** effect to invert the colors in an image

Hue	Opens Hue effect to adjust the hue of the entire image
Saturation	Opens Saturation effect to adjust the saturation of the entire image
Temperature	Opens Temperature effect to adjust your video image to warm or cold colors
Grayscale	Opens Grayscale effect to convert color images to just two color levels: black (0) and white (255)
Threshold	Opens Threshold effect to determine how much contrast there is between neighboring pixels for the sharpening to affect them
Colorize	Opens Colorize effect to colorize the entire file in an RGB-specified file
Posterize	Opens Posterize effect to specify the tonal level (or brightness values) and then map pixels to the closest matching level.

Effect : These effects permit us to introduce various painting, mosaic, blur and similar adjustments to our media file.

Name of Effect	Function
Deinterlace	Applies Deinterlacing effect to remove interlacing effect
Blur	Applies Blur effect to reduce contrast between adjacent pixels visually smoothing and softening the image
Gaussian Blur	Applies Gaussian Blur effect to reduce contrast between adjacent pixels according to a mathematical equation
Motion Blur	Applies Motion Blur effect to reduce contrast. This effect gives the impression of motion
Sharpen	Applies Sharpen effect increases contrast to seemingly bring the images into better focus
Mosaic	Applies Mosaic effect by clumping pixels of similar color values in cells

Noise	Applies Noise effect to add some texture to an image by way of tiny pixel dustings
Diffuse	Applies Diffuse effect to make the selection look less focused
Emboss	Applies Emboss effect to give an image a 3D look
Filter Minimal	Applies Filter Minimal effect to emphasize the dark pixels in an image
Filter Maximal	Applies Filter Maximal effect to emphasize the light pixels in an image
Median	Applies Median effect to replace each pixel with a pixel that has the median color value of neighboring pixels

Transform : The **Transform** effects permit us to introduce various transformations, such as rotation, shift and other to your media file. It also lets you reproduce the entire image or a part of it.

Name of Effect	Function
Flip	Opens Flip effect to flip an entire image horizontally or vertically
Perspective	Opens Perspective effect to transform the perspective in an image horizontally or vertically
Skew	Opens Skew effect to skew the entire image horizontally or vertically
Shift	Opens Shift effect to move your image along X and Y axes
Rotate	Opens Rotate effect to rotate the entire image
Resample	Opens Resample effect to reproduce the entire image
Zoom	Opens Zoom effect to magnify or reduce the image
Mirror	Opens Mirror effect to duplicate a part of the image
Twirl	Opens Twirl effect to twirl the image.
Sphere	Opens Sphere effect to make a certain sphere-shaped area blurred
Cylinder	Opens Cylinder effect to make a certain cylinder-shaped area blurred

Draw : The **Draw** effects permit us to introduce various objects, images and text messages to our media file.

Name of Effect	Function
Line/Polyline	Opens Line/Polyline effect to include various lines to your video file
Rectangle	Opens Rectangle effect to include various rectangular objects to your video file
Ellipse	Opens Ellipse effect to include various ellipse-shaped to your video file
Invert Rectangle	Opens Invert Rectangle effect to highlight an object in the video by setting out an rectangular-shaped "window" which remains free of color coverage
Invert Ellipse	Opens Invert Ellipse effect to highlight an object in the video by setting out an ellipse-shaped "window" which remains free of color coverage
Image	Opens Image effect lets you include any image to your video file
Border	Opens Border effect to put a border around the media image
Polygon, Pie, Simple Pie, Sector, Simple Sector	Opens Polygon, Pie, Simple Pie, Sector, Simple Sector menu to highlight an object in the video by setting out an object which is covered with specified color

HOW TO USE VIDEO ON PC:

Following hardware and software are required for using video on PC:

Hardware requirement for video:

- Intel Pentium III 800 MHZ (Pentium 4 / 3 GHZ recommended).
- Microsoft Windows XP Home (Microsoft Windows XP Pro recommended).
- 256 MB of RAM installed (1 GB or more recommended).
- CD-ROM drive (compatible DVD recordable drive required for Export to DVD).
- 24-bit color, DirectX compatible display adapter (1024x768 or higher recommended)
- DirectX compatible sound card (Multi-channel ASIO compatible sound card for surround sound support recommended)
- Dedicated large-capacity 7200 RPM UDMA 66 IDE or SCSI hard disk or disk array
- DV/i.LINK/FireWire connection (IEEE 1394 OHCI) or Adobe Premiere Pro certified 3rd party capture card

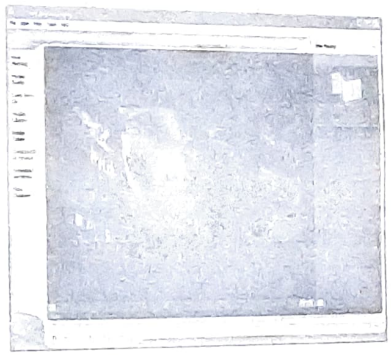
For the latest info on system requirements and 3rd party compatible hardware, you can refer to http://www.adobe.com/products/premiere/systemreqs.html

Software requirement for video:

You will need to ensure you have the correct software on your machine in order to view the video clips.

If you are using a PC

- You will need the free Windows Media Player



To enjoy videos at Online you will need the following software installed on your computer:

- Internet Explorer 6.0 or above, Firefox 1.5 or above, or Safari 2.0 or above
- JavaScript and Cookies must also be enabled
- Adobe Flash Player 9.0.115 or above
- Microsoft Windows XP SP2, Microsoft Windows Vista, Macintosh OS X or Linux
- Video recording and editing software

INTRODUCTION TO GRAPHICS ACCELERATOR CARDS:

To understand how to obtain a good screen image, we need to look at the complete video system. It consist of these three elements:

1. The graphics card (also called the video card or video adapter or **graphics-accelerator card**). It is an expansion card, which generates electric signals to the monitor.
2. The monitor itself, which is connected by a cable to the video card using some kind of *interface*.
3. A *device driver* which Windows uses to control the video card, to make it send the correct signals to the monitor.

These three elements must be fitted and matched to achieve quality images. Even the finest and most expensive monitor will only render mediocre images if it is connected through a low quality video card. All video cards depend on the right driver and proper settings to function properly – otherwise the card will not perform well. The Windows drivers link video card and monitor together, and make them cooperate with each other.

Now let us see" What are graphics accelerator cards and their characteristics? "

Definition: *"A graphics-accelerator card is an expansion card whose function is to generate and output images to a display Unit."* In other word we can say that *"A **graphics-accelerator card** is a type of video adapter that contains its own processor to improve performance levels. These processors are dedicated for computing graphical transformations, so they accomplish better results than the general-purpose CPU used by the computer. In addition, they free up the computer's CPU to execute other commands while the graphics accelerator is handling graphics computations."*

The fame of graphical applications, and particularly multimedia applications, has made graphics accelerators not only a common enhancement, but a necessity. Most computer manufacturers now bundle a graphics accelerator with their mid-range and high-end systems. Video hardware can be integrated on the main board, as it often happened with early computers; in this configuration it was sometimes referred to as a *video controller* or *graphics controller*.

A video adapter is board that plugs into a personal computer to give it display capabilities. Those capabilities of a computer, however, depend on both the logical circuitry (provided in the video adapter) and the display monitor. A monochrome monitor, for example, can't display color no matter how powerful the video adapter.

Following are the some characteristics of graphics accelerators:

1. **Memory**: *Graphics accelerators* have their own memory, which is reserved for storing graphical representations. The amount of memory determines how much resolution and how many colors can be displayed. Some accelerators use conventional DRAM, but others use a special type of video *RAM* (VRAM), which enables both the video circuitry and the processor to simultaneously access the memory.
2. **Bus**: Each graphics accelerator is designed for a particular type of video bus. As of 1995, most are designed for the PCI bus.
3. **Register width:** The wider the register, the more data the processor can manipulate with each instruction. 64-bit accelerators are already becoming common, and we can expect 128-bit accelerators in the near future.

3D Accelerated Graphics Cards

All ordinary graphics cards can show 3D games. When we talk about accelerating 3D programs, we are primarily talking about games. The three-dimensional games like *Forsaken*, *Battlezone* and Quake are very demanding for the PC to execute. The users want to see the games with high-quality details in a large screen window and with as many FPS (*Frames Per Second*) as possible. In recent years there has been a huge development in 3D graphics cards.

Now Let us see these graphics cards briefly. In the beginning there were two types of graphics cards, which could be used for 3D acceleration:

1. Combination 2D/3D cards. These are ordinary graphics cards, which have been equipped with extra 3D power.
2. The pure 3D cards, which only work as accelerators.

The pure 3D cards required that there also is an ordinary (2D) graphics card in the PC. In beginning the pure 3D card yielded the best acceleration, but there soon came good combination cards into the market.

The real 3D card: The 3Dfx company has set the *standard* for 3D execution with their Voodoo accelerator chips. The first version was launched in 1997 and it set the standard for 3D acceleration. The Voodoo accelerator chip came in 1998 at also became an huge success. This card cannot display 2D-images, so it needed to be installed in combination with an ordinary graphics card.

The Voodoo cards are special in that they do not use AGP. Many think that this is a big flaw in the architecture. At least this means that you cannot show 32 bit color depth (which is 24 bit colors with 8 additional bits for transparency). However, the difference between 24 bit and 32 bit colors is not always visible - according to experts ... Bundling two parallel Voodoo cards, each with 12 MB RAM, working in tandem (called SLI mode) in the same PC, yielded lots of power. That gave 3D games in a resolution of 1024X768 in 60 FPS.The Voodoo controller operated at 95 MHz and was produced using 0.35 micron technology. It was a chip set of three controllers (one pixel processor and two texture processors). The later Voodoo controller operated at up to 183 MHz and was produced using 0.25 micron technology. It only supported AGP 2X, which gave a great disappointment within the press.

Intel Combination 2D/3D graphic chip sets: To relieve the CPU, you can add certain 3D accelerator characteristics to the chip on the graphics card. Many companies have done that in recent years; of them Intel are intersting.

Intel's i740: In 1997 Intel teamed up with a company called Real 3D to produce a new graphics chip. The i740 chip was constructed to give maximum performance within two demanding areas:

1. 3D scenes
2. Video playback

The processor allows parallel data processing and gives precise pixel interpolation. Using AGP, an i740 based controller will be able to process very large amounts of data at a high speed. The i740 board works as a "normal" video card as well as 3D accelerator

i752

The chip i752 (code named "Portola") is the new generation 2D/3D graphics controller from Intel. It should be 5 times better than the i740. It includes 2D graphics, 3D rendering and digital video acceleration. The i752 also features AGP 2X.

According to Intel the power of the 752 set is found in:

The 3D visual quality being enhanced using Intel's new *HyperPipelined 3D architecture*. The Pixel Precise Engine includes new features as a 16 tap anisotropic filter, emboss bump mapping, texture compression, and texture compositing.

Enhanced digital video streams from a wide variety of input sources: VCR, camcorder, TV tuner, MPEG-2, and Web video streams. Software DVD is accelerated through a high-precision hardware-based motion compensation algorithm.A 128-bit 2D engine and support for high-resolution flat panels. The chip i754 (code named "Portola") is the next generation of this Graphics chipset, featuring AGP4X. A later high-end version is code named *Capitola*.

INTRODUCTION TO DIRECTX

Now let us see" What is DirectX?"

Definition: *"DirectX is a set of low-level Application Programming Interfaces (APIs) that provides Windows programs with high-performance hardware-accelerated multimedia support."*

Windows operating system supports *DirectX 8.1*, which improves the multimedia capabilities of your computer. *DirectX* provides access to the capabilities of your display and audio cards, which enables programs to provide realistic three-dimensional (3-D) graphics and immersive music and audio effects. *DirectX* enables the program to easily determine the hardware capabilities of your computer, and then sets the program parameters to match. This allows multimedia software programs to run on any Windows-based computer with *DirectX* compatible hardware and drivers and ensures that the multimedia programs take full advantage of high-performance hardware.

APIs of DirectX: *DirectX contains collection of APIs that offer access to the advanced features of high-performance hardware, such as 3-D graphics acceleration chips and sound cards.* These APIs control low-level functions, including two-dimensional (2-D) graphics acceleration; support for input devices such as joysticks, keyboards, and mice; and control of sound mixing and sound output. DirectX contains the following APIs (*Application Programming Interfaces*):

1. **Microsoft DirectDraw:** This API supports extremely fast access to the accelerated hardware capabilities of a computer's video adapter. It supports standard methods of displaying graphics on all video adapters, and faster, more direct access when using accelerated drivers. *DirectDraw* provides a device-independent way for programs, such as games and 2-D graphics packages, and Windows system components, such as digital video codecs, to gain access to the features of specific display devices without requiring any additional information from the user about the device's capabilities.
2. **Microsoft Direct3D:** This API (Direct3D) provides an interface to the *3-D rendering* functions built into most new video adapters. Direct3D is a low-level 3-D API that provides a device-independent way for software programs to communicate with accelerator hardware efficiently and powerfully. *Direct3D* includes support for specialized CPU instructions sets, providing additional acceleration on newer computers.
3. **Microsoft DirectSound:** This API provides a link between programs and an audio adapter's sound mixing, sound playback, and sound capture capabilities. *DirectSound* provides multimedia software programs with low-latency mixing, hardware acceleration, and access to the sound device. It provides this feature while maintaining compatibility with existing device drivers.
4. **Microsoft DirectMusic:** This API is the interactive audio component of DirectX. Unlike the DirectSound API, which captures and plays digital sound samples, DirectMusic works with digital audio, as well as message-based musical data that is converted to digital audio either by your sound card or by its built-in software synthesizer. The *DirectMusic* API supports input in Musical Instrument Digital Interface (MIDI) format, and supports both compressed and uncompressed digital audio formats. *DirectMusic* provides software developers with the ability to create immersive, dynamic soundtracks that respond to a variety of changes in the software environment, not the least of which is direct user input.
5. **Microsoft DirectInput:** This API provides advanced input for games and processes input from joysticks as well as other related devices including the mouse, keyboard, and force-feedback game controllers.
6. **Microsoft DirectPlay:** This API supports game connections over a modem, the Internet, or LAN. *DirectPlay* simplifies access to communication services and provides a way for games to communicate with each other, independent of the protocol, or online service. *DirectPlay* provides lobbying services that simplify the initialization of a multiplayer game, and supports reliable communication protocols to ensure that important game data is not lost on the network. New in *DirectPlay 8.0* is support for voice communication over the network, which will significantly improve the playability of multiplayer team-based games, and add a new dimension to social games by providing the capability to talk to other people playing the game.
7. **Microsoft DirectShow:** This API provides high-quality capture and playback of multimedia files located on your computer and on Internet servers. *DirectShow* supports a wide variety of audio and video formats, including Advanced Streaming Format (ASF), Audio-Video Interleaved (AVI), Digital Video (DV), Motion Picture Experts Group (MPEG), MPEG Audio Layer-3 (MP3), Windows Media Audio/Video (WMA/WMV), and WAV files. *DirectShow* enables video capture, DVD playback, video editing and mixing, hardware accelerated video decoding, and tuning of broadcast analog and digital television signals.

INTRODUCTION TO AV/DV AND IEEE1394 CARDS

AV/DV Cards:

Video cards are also known as *video adapters, display adapters, video controllers* and *video boards*. Basically, these are the electronic components that generate the video signal sent through a cable to your monitor. Sometimes, the video card is integrated with your motherboard. But high-end video cards are usually separate boards inside your PC.

If you have a low-end computer with a built-in video card on the motherboard, there's an even more compelling reason to upgrade to a new video card: your system is probably using shared RAM. This means that the on-board video card borrows from your main system RAM, which reduces the RAM you have available for video editing, which slows everything down.

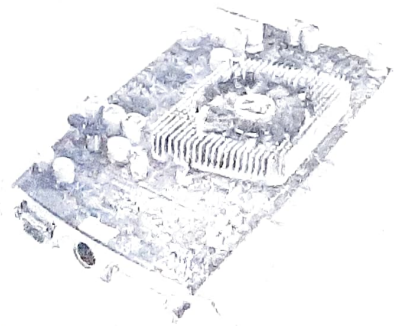


Figure : ATI's newest flagship product, the RADEON 9800 Pro.

Two major video card companies are competing for supremacy right now: *ATI Technologies* (see Figure) and *nVidia* (see Figure). The best video card really depends on your needs.

Figure : The tried-and-true GeForce4 Ti 4500. nVidia has recently released the GeForce FX 5900, their top-tier product.

Video converters enable you to easily convert analog audio and video to digital video - to convert digital video to analog video. You don't need to import the video to a computer, run a conversion software program and then wait for hours. These converters allow you to easily import analog video and audio from an older analog (VHS or 8mm) camcorder or VCR into your DV enabled computer. You can also output digital video productions from your computer back to your VCR, or VHS/8mm camcorder to make copies for distribution.

AV ToolBox DV-2001

DV-2001 DV-Analog Converter provides high quality, bi-directional conversion of DV and Analog video and audio. Convert a DV (i-Link/Firewire) audio/video signal into a standard composite or *S-Video signal* with stereo audio or vice versa. The unique hardware codec used in the DV-2001 allows this bi-directional, real-time conversion with excellent quality at a very cost effective price. The DV-2001 is the ideal companion for computers with DV Capture Boards because it allows you to hook up the DV Board to a standard TV Set or Video Monitor as well as most VCRs and Camcorders, including VHS, S-VHS, Video 8, Hi-8, etc. The unit is housed in a rugged metal case which makes it ideal for the professional and industrial market. The DV-2001 unit uses the professional DV10 chipset rather than a consumer level converter chip.

Canopus ADVC-50

The ADVC 50 enables you to convert your S-VHS, Hi8 or other analog video tapes to DV in one simple step. It supports locked audio during the conversion. It does not convert DV to analog. ADVC-50 is compatible with all OHCI and DV capture cards for Macintosh or PC. No need to install drivers or any applications. The easy to install ADVC-50 allows convenient access to video cabling when fitted into the computers 5-¼ inch Bay. Alternatively the ADVC-50 can be installed internally as a standard PCI card. The ADVC-50 unit uses the PC's standard 4-pin connection for power supply (bay installation).

Dazzle Hollywood DV Bridge

Need to convert DV to analog or convert analog (VHS, 8m video) to DV. This is a simple way to get analog video in and out of a firewire/1394/iLink equipped computer. Targeted to home users and consumers, it includes video editing and DVD authoring software.

With *Hollywood DV-Bridge*, you can convert your old VHS tapes to high-quality DV video. The video world is moving from analog to DV and converting your video to DV ensures it will be around for the future in a standardized high-quality format. You can also convert your DV video to analog. This makes it easy to send videotapes to people with analog VCRs or camcorders. You can even take clips from your analog and DV tapes and combine them into one master production. With Hollywood DV-Bridge, you edit your video in the DV format, which means you won't lose any video quality in the editing process. *Hollywood DV-Bridge is the universal solution for converting and editing analog and DV video.*

Many videographers are in a middle of a transition, evolving from analog formats like VHS and 8mm, to the digital video format. Many of us have drawers full of old 8mm and Hi8mm tapes, boxes full of old VHS and S-VHS cassettes, all packed full of wonderful moments and memories. It would be great to be able to save them to easily digitize and save them for prosperity, transferring that electronic data to digital videotape. Once on DV tape, you could then make copies without worrying about generation loss every again. With the proper computer equipment, you could edit and copy the best parts to CD-ROMs and DVDs. Maybe you have been shooting DV for some time and have a pile of DV tapes as well.

No Copy Protection

One of the more interesting aspects of the Dazzle Hollywood DV Bridge is that copy protection is not enabled. Unlike the more expensive and professional Sony MA2 as well as almost every VCR and Digital Video Camcorder, the DV Bridge enables you to make perfect DV copies of pre-recorded commercial videos. I tested it using a tape from my local video rental store and was able to copy it perfectly to my DV camcorder using the DV recording function. The camcorder did not get go into auto shut-off mode as it would when connected to the VCR via the analog video and audio input connectors. I got no signal rolling or color shifting. It looked and sounded great.

IEEE 1394 Card:

Now let us see" What is IEEE 1394 (Firewire Or iLink) Card ?"

The best way to capture high-quality digital video is using a digital video capture card such as IEEE 1394, also known as firewire, or on Sony systems, i.Link.

IEEE 1394(Firewire Or iLink) Card

Definition: *"IEEE1394 is a type of peripheral connection which has similarities to that of USB, but with substantially higher data transfer capabilities."*

Where USB can transfer up to 12Mbits/s, IEEE1394 can handle a whapping 400MBits/s. This large pipeline has made Fire Wire an ideal choice for fast data transfer from digital cameras or other multimedia devices. Many consumer grades Sony camcorder records video in digital format on tape and it has i.Link (IEEE 1394) output. This type of output offers a high data transfer rate — up to 400Mbps — which is necessary to transfer the large volume of data required for full-motion video. All you need for Windows XP to capture this digital video directly from the camera is an OHCI-compliant *IEEE 1394 port*. Many newer computers have these ports built in. If yours doesn't, several companies offer 1394 cards for well under Rs.5000. These are easy to install if you have an open slot in your desktop computer. There are also 1394 cards available for laptops.

Just make sure of the OCHI compliancy before purchasing. OHCI stands for Open Host Controller Interface, and is an industry standard for *IEEE 1394* interfaces. Microsoft worked very hard during Windows XP's development to make sure that both Windows XP and a majority of the available 1394 products were OHCI-compliant. *Digital IEEE 1394* card shown in Figure 1 below the box is OHCI-compliant, and the card has an NEC 1394 chip on it, which Windows XP supports. You simply plugged the card in, turned on the computer, and Windows XP recognized it and installed all necessary drivers without your having to make a single click.

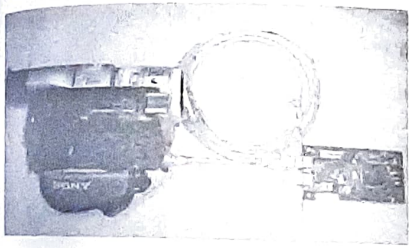


Figure 1 : Digital IEEE 1394 card

To get started capturing video

1. Open **Movie Maker** (Click **Start**, click **All Programs**, click **Accessories**, and then click **Windows Movie Maker**.)
2. Click **Record**. The Record window opens with a preview of your video, along with options for your source device, encoding quality, and target platforms.

   You'll also observe that, if you are using an IEEE 1394 devices, a set of controls appears at the bottom of the window for controlling your. These buttons control your camera so your hand never has to leave your mouse. Alternatively, you can use the buttons on your camcorder to start and stop the playback.
3. Clear the **Record time limit** and **Create clips** check boxes if you don't wish to take advantage of those features.
4. Also, you might want to check the **Disable preview while capturing** box. This can improve performance since displaying the video takes up some CPU power.

The **Setting** quality is important. You can choose **Low quality**, **Medium quality**, **High quality** or **Other**. Click on each setting and read the text below it that describes the bitrate, size, and frame rate of the final video.

Clicking **Other** lets you choose from a wide variety of encoding profiles to better suit your desired target. For example, you can select options that are well-suited for playback on a Pocket PC, for low-bandwidth streaming over a modem, or for very high bitrates for archival quality and playback from CDs or hard disks. Experiment with these settings until you become familiar with the tradeoffs between quality and bitrate and find the right selection for your desired result.

After you experiment with quality settings, you can begin capturing video, whether it's prerecorded, or live, and use Movie Maker to edit it and produce the final movie.

DIGITIZATION OF ANALOG VIDEO TO DIGITAL VIDEO

Now let us see" What is Digitization?"

Definition: *"Digitization is the process of converting information into a digital format. In this format, information is organized into discrete units of data (called bit s) that can be separately addressed (usually in multiple-bit groups called byte s). This is the binary data that computers and many devices with computing capacity can process."*

Audio and video digitization uses one of many analog-to-digital conversion processes in which a continuously variable (analog) signal is changed, without altering its essential content, into a multi-level (digital) signal. The process of sampling measures the amplitude (signal strength) of an analog waveform at evenly spaced time markers and represents the samples as numerical

values for input as digital data. Digitizing information makes it easier to preserve, access, and share. For example, an original historical document may only be accessible to people who visit its physical location, but if the document content is digitized, it can be made available to people worldwide. There is a growing trend towards digitization of historically and culturally significant data.

Now let us see" What is analog-to-digital conversion (ADC)?"

The compliment to the digital to analog converter is the **analog to digital converter**. An analog to digital converter converts analog voltages to digital information that can be used by a computer. It is useful to note that the digital data produced by an analog to digital converter is only approximately proportional to the analog input. That's because a perfect conversion is impossible due to the fact that digital information changes in steps, whereas analog is virtually continuous, at least down to the subatomic level.

Definition: *"Analog-to-digital conversion is an electronic process in which a continuously analog signal is changed, without altering its essential content, into a multi-level (digital) signal."* In other words we can say that" *Analog-to-Digital Conversion (ADC) is the process of converting analog signals to a digital representation."*

The input to an *analog-to-digital converter (ADC)* consists of a voltage that varies among a theoretically infinite number of values. Examples are sine waves, the waveforms representing human speech, and the signals from a conventional television camera. The output of the *ADC*, in contrast, has defined levels or states. The number of states is almost always a power of two — that is, 2, 4, 8, 16, etc. The simplest digital signals have only two states, and are called binary. All whole numbers can be represented in binary form as strings of ones and zeros.

Digital signals propagate more efficiently than analog signals, largely because digital impulses, which are well-defined and orderly, are easier for electronic circuits to distinguish from noise, which is chaotic. This is the chief advantage of digital modes in communications. Computers "talk" and "think" in terms of binary digital data; while a microprocessor can analyze analog data, it must be converted into digital form for the computer to make sense of it.

A typical telephone modem makes use of an *ADC* to convert the incoming audio from a twisted-pair line into signals the computer can understand. In a digital signal processing system, an *ADC* is required if the signal input is analog.

We can also convert an analog video to digital video. To digitize an analog video, first of all connect a video-capture card to your computer. This card helps convert an analog video to a digital one by connecting the **comcorder** to the computer. There are three (3) types of connections that can be made with the help of a video capture card.

(i) *Composite*

(ii) *S-Video*

(iii) *Component*

with all connection, the quality of digitization dimenshes. Therefore, if the video that you need is only experimental and less expensive, you can use any of the first two connections. If the video is very significant and expensive, you can use the component connection. The process of digitizing an analog video is shown in Fig.

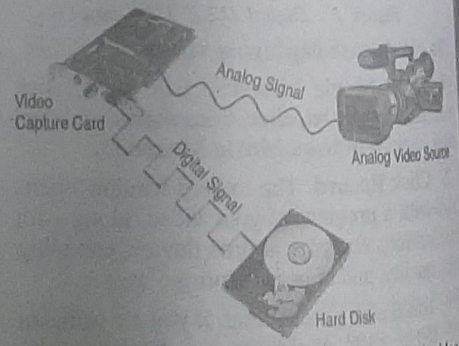


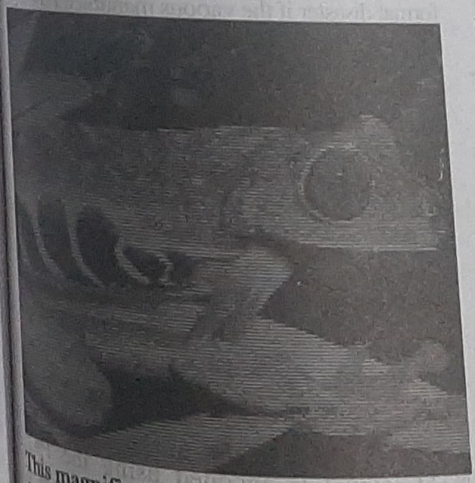
Fig. Digitization of Analog video to digital video

INTERLACING AND NON-INTERLACING

Now let us see" What is Interlacing and non-Interlacing?"

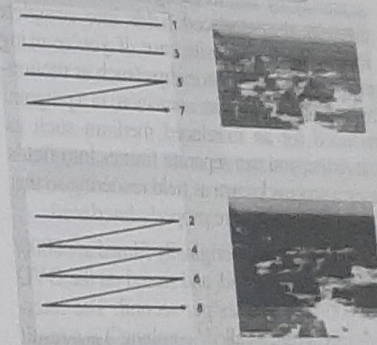
Both a TV screen and a computer monitor are drawn, or refreshed, with small horizontal lines made up of closely spaced red, green, and blue dots. An electron beam inside your TV or monitor draws these lines over and over again. Analog or digital video can be classified as interlaced or non-interlaced (progressive scan). Video programs using the *NTSC, PAL* and *SECAM* standards are interlaced, where each frame consists of two fields displayed in two passes. Most personal computers display using *non-interlaced* (progressive scan), in which all lines in a frame are displayed in one pass from top to bottom before the next frame appears.

Definition: *"Interlacing is an alternating display style that helped make up for slow refresh speeds (slow drawing speeds). When interlacing, the electron beam draws odd lines first, then goes back and draws even lines. Because your eye tends to blend and balance little differences in light, color and intensity, this method made the changing image on the screen appear less noticeable."* In other words we can say that *"Interlacing is the practice of displaying a single frame of video as two 'half' frames. Each frame is split into alternating lines, so that the first frame displays lines 1, 3, 5 and so on, while the second frame of the pair displays lines 2, 4, 6 and so on".*



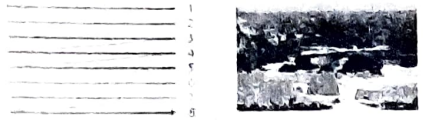
This magnified image illustrates the fine lines.

Interlacing also saves on storage and so it's considered a method of data compression–more data fits into a smaller space when interlaced. But some of the data is lost in the process. In the early 1990s, interlaced computer monitors (and video cards) were all the rage. But now we use **non–interlaced** (progressive) scan monitors (non–interlaced–lines are drawn top to bottom, one after another). Why? Because the refresh speed has increased to such a point that interlacing is no longer needed. At lower speeds, interlacing generally delivers the illusion of a better picture. Current computer monitors have been using the progressive scan method for years now. Except for some versions of HDTV, television screens and television broadcasts still use the interlace method to display video data.



In interlaced video, a frame is divided into two fields. Each field contains every other horizontal line in the frame. A TV displays the first field of alternating lines over the entire screen, and then displays the second field to fill in the alternating gaps left by the first field. One NTSC video frame, displayed approximately every 1/30th of a second, contains two interlaced fields, displayed approximately every 1/60th of a second each. PAL and SECAM video frames display at 1/25 of a second and contain two interlaced fields displayed 1/50th of a second each. The field that contains the topmost scan line in the frame is called the upper field, and the other field is called the lower field. When playing back or exporting to interlaced video, make sure the field order you specify matches the receiving system, otherwise motion may appear stuttered

and edges of objects in the frame may break up with a comb-like appearance.



Interlaced video describes a frame with two passes of alternating scan lines. **Non–interlaced** (progressive-scan) video describes a frame with one pass of sequential scan lines.

If you plan to slow down or hold a frame in a clip, you may want to prevent flickering or visual stuttering by deinterlacing its frames, which converts the interlaced fields into complete frames. In the opposite case, if you're using progressive-scan source clips (such as motion-picture film or computer animation) in a program intended for an interlaced medium such as television, you can separate frames into fields using a process known as field rendering so that motion and effects are properly interlaced.

Interlaced video was originally filmed at 60000/1001 fields per second, and stored on the DVD as 30000/1001 frames per second. The interlacing effect (often called "combing") is a result of combining pairs of fields into frames. Each field is supposed to be 1/(60000/1001) seconds apart, and when they are displayed simultaneously the difference is apparent.

BRIEF NOTE ON VARIOUS VIDEO STANDARDS

Now let us see" WHAT IS NTSC & PAL STANDARD?"

Although VHS video format is the same throughout the World, the video standard or electronic signal that is recorded on the cassette varies from country to country. The two most common video standards used are NTSC and PAL.

NTSC (National Television Systems Committee): NTSC stand for National Television Systems Committee. A committee of the Electronic Industries Association that prepared the standards for commercial television broadcasting in the United States, Canada, Japan, and parts of Central and South America. The NTSC format has 525 scan lines (rows) of resolution at frame rate of thirty frames per second.

Definition: *"NTSC is the video system or standard used in North America and most of South America. In NTSC, 30 frames are transmitted each second. Each frame is made up of 525 individual scan lines."*

NTSC standard was introduced in the US in 1941 as the first set of standard protocols for television. NTSC has 525 lines displayed at 30 frames per second in a 2:1 interleave. It has a lower resolution than PAL or SECAM but a faster frame rate, which reduces flicker. Though color stability is acceptable in a closed system (ie: direct video to video), broadcast of the composite signal often results in reflections and multi-path signals being received by the antenna. The result: phase distortion resulting in varying color. Engineers lovingly defined NTSC as actually meaning "Never The Same Color".

The first broadcasts were made in 1939, transmitting 340 lines at 30 frames/sec, as demonstrated at the opening of the New York World's Fair. As there were no standards set at that time, there were a mish mash of other systems soon to be adopted - each one incompatible with the other. This was clearly going to be a format disaster if the various manufacturers were left to their own competitive devices. The FCC finally stepped in to the confused mayhem and founded the NTSC who set the standards in use today.

1. Initially adopted in 1941 and modified in 1953 to include the standards for color.
2. Additional stereo specs were adopted in 1986 and the digital standard adopted in 1996.
3. The actual spec in use today is NTSC-M though it's just called NTSC.

Variations: NTSC 4.43

A variation of NTSC-M where a 525/59.94 NTSC signal is encoded using the PAL subcarrier frequency and chroma modulation. It is NOT PAL, nor is it it encoded as PAL, but rather it is NTSC color just using PAL's subcarrier frequency. Most (but not all) multi-system Vcr's will support this mode, but only multi-standard monitors are capable of reproducing it.

System	NTSC M
Lines/Field525/60	
Horizontal Frequency	15.734 kHz
Vertical Frequency	60 Hz
Color Subcarrier Frequency	3.57954545 MHz ±10 Hz
Video Bandwidth	4.2 MHz
Sound Carrier	4.5 MHz

PAL (Phase Alteration Line):

PAL stands for Phase Alteration Line. This standard is used for commercial *broadcasting* in most of Europe, Australia, and parts of Central and South America. PAL format displays at *625 scan lines* (rows) of resolution at frame rate of *25 frames per second.*

Definition: *"PAL is the predominant video system or standard. In PAL, 25 frames are transmitted each second. Each frame is made up of 625 individual scan lines."*

Variations: There are two variations that have been developed:

1. PAL-M 2. PAL-N.

The main difference between PAL and PAL-M is a lower resolution (525 lines instead of 625) and a higher frame count (30 frames per second at 60Hz versus 25 frames per second at 50Hz). PAL-M grew out of NTSC as an attempt to correct the inherent color problems of NTSC. PAL-M is essentially PAL at NTSC line and frame rates. The only major difference is how the color is processed, ie: the sub-carrier frequency.

PAL-N is effectively PAL (identical frame/scan rate), but uses a 3.582056 MHz chroma subcarrier. PAL-N in engineering circles is known as "*Chrominance Lock Technique*". Without going into a long technical dissertation on PAL subcarrier like we did with NTSC, PAL-N was simply a more sophisticated delay-line technique which could better track and cancel differential phase distortions especially encountered in remote/mountainous areas. With subsequent improvements in tuners and filtering techniques, the reality was, that it didn't "buy" much and was never widely adopted. The only countries employing PAL-N are Argentina, Paraguay & Uruguay. Note that attempting to display a PAL signal on a PAL-N monitor will result in only a monochrome image.

Now let us see" What are the PAL-B, G, H, I & D Variations all about?"

Pal-B, G, H, I and D as far as the actual video is concerned, are all the same format. That is they are all PAL. There is no difference. All use the 625/50 line/field rate. Scan at 15,625 h-lines/sec and use a 4.433618 color subcarrier frequency & PAL color processing. The only difference is in how the signal is modulated by the TV Station transmitter for broadcast. Thus the B, G, H, I & D variants, designate the broadcast frequency carriers used, as opposed to any variation of the video format itself. PAL-I for example, has been allocated a wider transmitter bandwidth than PAL-B, necessitating that the sound carrier resides 6Mhz above the picture instead of 5.5 MHz above the picture carrier. Therefore a PAL-I TV will receive no sound if taken to the Netherlands (PAL-B) if all the TV's tuner is able to decode is PAL-I.

This is why for example, you won't find a standards converter that will convert a video from PAL-B to PAL-I. There is simply nothing to convert. They are already the same PAL format. Put another way; the B, G, H, I & D variants specify the broadcast frequencies used to broadcast the PAL video & audio by your local/national TV stations, and thus the necessary supported capability of the TV Tuner of your receiver to properly receive it. There are major differences between PAL-M and PAL-N however, as they specify not how the audio and video are broadcast, but rather specify variants of the video format itself. Thus Pal-M & N would require conversion, as the line/field rate and color subcarrier frequencies are different from standard PAL.

PAL - Phase Alternating Line					
SYSTEM	PAL B,G,H	PAL I	PAL D	PAL N	PAL M
Line/Field	625/50	625/50	625/50	625/50	525/60
Horizontal Frequency	15.625 kHz	15.625 kHz	15.625 kHz	15.625 kHz	15.750 kHz
Vertical Frequency	50 Hz	50 Hz	50 Hz	50 Hz	60 Hz
Colour Sub Carier Frequency	4.433618 MHz	4.433618 MHz	4.433618 MHz	3.582056 MHz	3.575611 MHz
Video Bandwidth	5.0 MHz	5.5 MHz	6.0 MHz	4.2 MHz	4.2 MHz
Sound Carrier	5.5 MHz	6.0 MHz	6.5 MHz	4.5 MHz	4.5 MHz

To determine your video standard refer to the table below:

PAL	NTSC
Afghanistan	Canada
Algeria	Chile
Argentina (N)	Costa Rica
Austria	Cuba
Australia	Dominican Republic
Bangladesh	Ecuador
Belgium	Japan
Brazil (M)	Mexico
China	Nicaragua
Denmark	Panama
Finland	Peru
Germany	Philippines
Hong Kong	Puerto Rico
Iceland	South Korea
India	Taiwan
Indonesia	U.S.A.
Iraq	
Italy	
Jordan	
Kenya	
Kuwait	
Liberia	
Malaysia	
Netherlands	
Nigeria	
Norway	
Pakistan	
Singapore	
South Africa	
South W. Africa	
Sudan	
Sweden	
Switzerland etc.	

SECAM(*Sequential Color Avec Memory*): SECAM stands for *SEquential Couleur Avec Memoire or Sequential Color Avec Memory*. SECAM was developed in France. This system uses the same resolution of PAL, 625 lines, and frame rate, 25 per second, but the way SECAM processes the color information is not compatible with PAL.

Definition : *"SECAM is the video system or standard used in France and many eastern European countries. The SECAM system also has 625 lines and offers good picture detail and stable hues."*

SECAM uses an FM color subcarrier that carries the color difference signals somewhat similar to PAL. But instead of all the color difference information being transmitted all at once, in SECAM the color difference signals are transmitted sequentially that is: R-Y on one line and B-Y on the next. A delay line in the receiver provides the necessary time delay for making R-Y and B-Y available for display at the same time and thus the term "Memoire" as part of the standard's name.

Variations: There are some other variations of SECAM: **SECAM-L** (also known as French SECAM) used in France and its' now former territories, **MESECAM** and **SECAM-D** which is used primarily in the C.I.S. and the former Eastern Block countries. Naturally, none of the three variations are compatible with even one another.

Following table shows the comparison of various variation of SECAM.

SECAM - Sequential Couleur Avec Memoire		
SYSTEM	SECAM B,G,H	SECAM D,K,K1,L
Line/Field	625/50	625/50
Horizontal Frequency	15.625 kHz	15.625 kHz
Vertical Frequency	50 Hz	50 Hz
Video Bandwidth	5.0 MHz	6.0 MHz
Sound Carrier	5.5 MHz	6.5 MHz

List of countries using the SECAM TV Standard are as follows:

Country	TV Standard	Voltage	Hertz	Plug
Benin	Secam-K	-	-	-
Bhutan	-	-	-	-
Bulgaria	Secam-D/K	220	50	-
Burkina Faso	Secam-K	220	50	B
Burundi	Secam-K	220	50	B
Central African Republic	Secam-K	220	50	B
Chad	Secam-K	220	50	B
Comoros	-	-	-	-
Congo	Secam-K	220	50	-
Cyprus	Secam-B/G	240	50	B/D
Djibouti Dem Republic	Secam-K	-	-	-
Egypt	Secam-B	110/220	50	B/D
France	Secam-L	220	50	B
Gabon	Secam-K	-	-	-
Greece	Secam-B	220	50	B
Guadalupe	Secam	-	-	-
Guiana (French)	Secam-K	-	-	-
Guinea	-	220	50	B
Guyana	Secam-K	110/220	-	A/B/D
Hungary	Secam-D/K	220	50	B
Iran	Secam-B	220	50	B
Iraq	Secam-B	220	50	B/C

HDTV (*High-Definition Television*): HDTV is Short for *High-Definition Television*. HDTV contains over two million individual pixels, resulting in pictures six to ten times sharper than SDTV. Although by early 2009 all TV stations in the U.S. should be digital, digital does not (necessarily) mean high definition.

Definition: *"HDTV is a new type of television that provides much better resolution than current televisions based on the NTSC standard."*

In other words we can say that *"HDTV is a digital TV broadcasting format where the broadcast transmits widescreen pictures with more detail and quality than found in a standard analog television or other digital television formats. Or "*HDTV is a type of Digital Television (DTV) broadcast, and is considered to be the best quality DTV format available."

Types of HDTV displays include *direct-view, plasma, rear screen* and *front screen projection*. HDTV requires an HDTV tuner to view and *the most detailed HDTV format is 1080i*

The table below compares the basic attributes of U.S. SDTV and HDTV television systems. Note that, although we consider HDTV to have 1,125 lines, only 1,080 of these are "active" or visible on the screen.

Standards	SDTV (Analog)	HDTV (Digital)
Total Lines	525	1125
Active Lines	480-486 (maximum visible on the screen)	1080 (maximum visible on the screen)
Sound	Two channels (stereo)	5.1 channels (surround sound)
Max Resolution	720 X 486	1920 X 1080

The Anatomy of Digital TV Signals

Unlike SDTV, which has only one broadcast standard in the United States, eighteen digital standard options exist within the new U.S. DTV/HDTV standards.

DTV standards vary in three ways.

- **Active lines of resolution:** 1,080 and 720 for HDTV; only 480 for SDTV.

- **Types of scanning:** Interlaced (two fields, each consisting of half the lines merge to make one complete frame or picture), and progressive (all lines transmitted together without interlacing).
- **Scan rate:** 60 or 50 fields per-second for interlaced, 30 or 25 frames per second for progressive, and 24 frames per-second for film-style progressive scan.

We now commonly use 24 fps in high-definition video production — especially when a need exists to convert the results to film. *Attack of the Clones*, the Star Wars film release of 2002, was one of the first "films" done on 24-progressive video and then converted to film.

HDTV Minimum Performance Attributes:

1. **Receiver:** Receives ATSC terrestrial digital transmissions and decodes all ATSC Table 3 video formats
2. **Display Scanning Format:** Has active vertical scanning lines of 720 progressive (720p), 1080 interlaced (1080i), or higher
3. **Aspect Ratio:** Capable of displaying a 16:9 image1
4. **Audio:** Receives and reproduces, and/or outputs Dolby Digital audio.

INTRODUCTION TO VIDEO CAPTURING MEDIA & INSTRUMENTS

Following are the video capturing media:

1. Videodisk 2. Magnetic tape

1. Videodisk (VCD):

Now let us see" What is Video Compact Disc?"

Definition: *"Video CD (VCD) is a format that allows video to be played back in computers or players that support the Video CD standard. The advantage of Video CD is that it can be created using a CD writer; a DVD writer or reader isn't required."*

VCD stands for 'Video Compact Disc' and basically it is a CD that contains moving pictures and sound. If you are familiar with regular audio/music CDs, then you will know what a VCD looks like. A VCD has the capacity to hold up to 74/80 minutes on 650MB/700MB CDs respectively of full-motion video along with quality stereo sound. VCDs use a compression standard called MPEG to store the video and audio. A VCD can be played on almost all standalone DVD Players and of course on all computers with a DVD-ROM or CD-ROM drive with the help of software based decoder / player. The quality of a very good VCD is about the same as a VHS tape based movie but VCD is usually a bit more blurry.

A VCD can be played on:

1. Standalone VCD Players (very common in ASiA)
2. Almost all standalone DVD Players
3. Playstations with VCD-addon
4. Sega Saturn with VCD-addon
5. Dreamcast with VCD-addon
6. And of course on all computers with a CD-ROMs/DVD-ROMs with a software VCD/MPG Player.

VCD does have a few advantages over DVD-Video:

- The VCD format has no region coding, therefore discs can be played on any compatible machine worldwide. Many VCD players can compensate for the differing frame rate and pixel count between NTSC and PAL/SECAM TV systems.
- Some titles available on VCD may not be available on DVD and/or VHS in the potential buyer's region.

2. Magnetic tape:

Now let us see"What is Magnetic tape?"

Definition: "Magnetic *tape is an external storage device that can be used for making copies of audio, video, and data. In addition to data storage, magnetic tape has been used over the years to make master copies of audio recordings that would be replicated for cassette, and more recently compact disk recording formats."*

The look of magnetic tape is similar in all of its incarnations. The tape is a simple strip of plastic that is very narrow in appearance. A thin *oxide coating* on the plastic makes it possible for the tape to retain electronically encrypted data that can range from voice to audio to data information. This makes magnetic tape a best method to back up customer databases, computer generated detail, and billing database information.

The tape is employed with the use of a machine referred to as a tape drive. Tape drives run the magnetic tape during the recording process and also store the tape onto a reel for easy retrieval. A lot of businesses use magnetic tape to create backup copies of programs and databases that are necessary to the operation of the company. Over and over again, the backup recordings are made after the business day is over. In the event that the company operates around the clock, it is not remarkable for the magnetic tape backup to begin at midnight, thus creating a record of all activity up to and including the current calendar day. Magnetic tape backups help to ensure that if the main computer memory becomes inoperable for some reason, necessary data can be restored with the use of the backup.

At the same time as a wide range of computer storage substitutes are available today, magnetic tape continues to be a popular option when it comes to backing up computer memory systems. The reels of magnetic tape are relatively easy to store and can be labeled for quick retrieval when necessary. Many companies choose to maintain a bank of magnetic tape copies in addition to utilizing online data storage and other means of creating system backups.

Video capturing Instruments:

Now let us see" What are various video capturing Instruments?"

Following are the video capturing Instruments:

1. DVCAM 2. Camcorder

DVCAM (Digital video cameras):

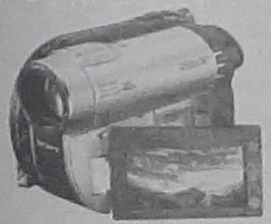


Figure: Sony Digital Video Camera - Mini DVD - MODELS OF 2007

Digital video cameras come in two different image capture formats that are as follows:

1. *Interlaced and*
2. *Progressive scan*

1. **Interlaced digital video cameras:** Interlaced cameras are video cameras that record the image in alternating sets of lines: the odd-numbered lines are scanned, and then the even-numbered lines are scanned, then the odd-numbered lines are scanned again, and so on. One set of odd or even lines is referred to as a "field", and a successive pairing of two fields of opposite parity is called a *frame*.

Figure: Wespro Digital Handicam DV504H (Digital video recorder: Record DVD quality video clips upto 30FPS with MPEG-4 technology. In-built flash & 2/10 seconds self timer. Preview recordings on its 2.4"(61mm) LCD screen. Can also be used as a Web Cam)

2. **Progressive digital video camera:** A progressive scanning digital video camera is a special type of video camera that records each frame as separate, with both fields being identical. Thus, interlaced video captures twice as many fields per second as progressive video does when both operate at the same number of frames per second.

Salient Features of Sony DCR 710 DVD Handycam:

Now let us see "What are various features of a DVCAM?"

1/6" Advanced HAD CCD Imager, 680K Pixels (Gross): 1/6" Advanced HAD (Hole Accumulation Diode) CCD with 680K (effective) pixels provides stunning detail and clarity with exceptional video (up to 500 lines of horizontal resolution) and still image performance.

25X Optical / 2000X Digital Zoom: The optical zoom helps to bring the action close up from far away. In addition, Digital Zoom Interpolation

means that extreme digital zooming is clearer, with less distortion than previous types of digital zoom.

Professional Quality Carl Zeiss Vario-Tessar Lens: Carl Zeiss Vario-Tessar lenses are designed specifically for compact camcorders, and utilize accuracy ground optics to maintain the sharpness and contrast found with larger lenses.

DVD Format Video Recording: The DVD recording format in MPEG2 (SD) delivers digital picture and sound quality comparable to that of MiniDV, but on DVD.

DVD-R/-RW/+RW and +R DL (Dual Layer) Compatible: Compatibility with a variety of DVD formats allows the ease-of-use and simplicity found in DVD media. With DVD+RW media there is no need to finalize the disc (minimum recording required); simply remove the finalized disc and insert the media into a compatible DVD or Blu-ray Disc Player.

Hybrid Recording to DVD or Memory Stick Media: Hybrid recording technology delivers a new level of flexibility for transferring your video footage and digital photos from the camcorder to compatible viewing devices.

Quick On: Missing an important scene can be frustrating, especially if the reason is because your camcorder is turned off. With the Quick On feature, the touch of a single button places that camcorder in Sleep mode. Another push instantly wakes the camcorder; therefore you will always be ready to capture special moments.

2.7" Wide1 (16:9) Hybrid Touch Panel Clear Photo LCD Plus Display (211K Pixels): The 2.7" Wide1 (16:9) LCD screen provides exceptional viewing clarity with improved resolution (211K pixels). The widescreen format makes shooting in 16:9 mode and composing shots even easier.

Memory Stick PRO Duo Media Slot: Capture still images directly onto Memory Stick PRO Duo media (sold separately) for easy transfer to PCs for emailing, printing, or sharing with other compatible Memory Stick devices.

Super SteadyShot Image Stabilization System: An advanced version of Sony's SteadyShot Image Stabilization system that controls an even higher range of shake and vibration frequencies, to achieve an even higher level of smoothness without degradation of video like some other image stabilization systems.

InfoLITHIUM Battery with AccuPower Meter System: Unlike NiCad (Nickel Cadmium) batteries, Sony's rechargeable Lithium Ion batteries are not subjected to a life shortening "Memory Effect," so you're free to charge the battery at any time. Additionally, Sony's exclusive AccuPower meter displays the battery time remaining in minutes, in either the viewfinder or on the LCD screen.

Manual Focus: Manually adjust the focus of the camcorder using the touch panel. Manual focusing also allows the user to control the focus in difficult situations where either the environment or the subject does not allow the camcorder's auto focus to perform optimally.

Super NightShot Plus Infrared System: The Super NightShot Plus Infrared System uses a slow shutter mode to let you shoot video with improved color and contrast, even in total darkness (0 lux).

Stamina Battery Power Management System: When using the Sony InfoLITHIUM Battery, the Stamina Battery Power Management System helps the camcorder prolong battery life for extra long continuous recording times from a single charge.

Scene Selection Modes: Scene Selection modes make recording easy even when filming in challenging situations. Choose from Auto, Twilight, Candle (move only), Sunrise & Sunset, Fireworks (move only), Landscape, Portrait, Spotlight, Sports (movie only), Beach, and Snow.

Picture Effects: Get creative when recording or playing back your videos with Sony's Picture Effect Modes. Effects available in Monotone, Sepia and Pastel.

Visual Index Screen: Shows thumbnail images of video clips and still images when playing back on your camcorder or DVD player, making your selection easier.

Battery Information: At the touch of a button, battery information is displayed on the LCD screen when charging and when the camcorder is turned off. When using the LCD screen or viewfinder, the display will show how much the battery is charged — in 10% increments — and the recordable time left.

Easy Handycam Button: With a press of the Easy Handycam Button, most of the advanced features of the camcorder are "locked out," letting you focus only the buttons essential for recording.

Multi-Language Menu: Change the menu display from English to English (Simplified), Canadian French, Latin American Spanish, or Brazilian Portuguese

Camcorder:

Camcorder is an electronic device used for video and audio recording. It is a combination of a video camera and a video recorder. Selecting a camcorder basically depends on its handling features, in-built technology, and pricing. therefore, with respect to specific needs there are various formats of a camcorder like VHS, VHS-C, 8mm, Hi8, Mini Digital Video (Mini DV), DVD and Digital 8. *Camcorders* of VHS format are highly basic and cheapest from all. Among all, the Mini DV type is best in both price and quality.

Figure: Polaroid Studio4 Camcorder (Digital video camera MPEG-4 format Zoom 12X MPEG-4 format 1.5" LCD 16MB internal memory PictBridge enabled Direct printing).

Figure: 8 mm Camcorder

Definition: "*Camcorder is an electronic device that contains both a video camera and recording device. They are generally a small portable device that can record live video and generally audio as well. Camcorders support playback of the captured video through consumer electronics such as a VCR, TV or computer.*" In other words we can say that" *A camcorder (camera recorder) is a portable electronic recording device capable of recording live-motion video and audio for later playback. Camcorders have three major components — a lens that gathers and focuses light, an imager that converts light into an electrical signal, and a recorder that converts electrical signals into digital video and encodes them for storage.*"

Camcorders, which became well-liked in the early 1980s, are also known as video recorders or video cameras. Professional videographers and filmmakers use camcorders to produce video segments and films for commercial sale. The devices are also popular with amateur videographers.

The first camcorders recorded in one of two analog formats, VHS and Betamax formats. Recordings were stored on video tape cassettes and replayed with a video tape cassette recorder (VCR) hooked up to a monitor, typically a TV set. As technology improved, other formats such as S-VHS, 8mm, Hi-8, and digital video (DV) and high definition video (HDV) became available. These formats offered a sharper picture, better color, more hours of recording and more efficient storage.

Today, camcorders record in a variety of formats, including MP4. Most camcorders can be connected directly to a personal computer with a Universal Serial Bus (USB) so that video can be edited.

Now let us see" What are the major components of Camcorders?"

Major components Camcorders:

There are three (3) major components in Camcorders. These are as follows:

1. *lens*
2. *imager*
3. *recorder*

Lens : This is the first component in the light path. The camcorder's optics generally has one or more of the following adjustments:

1. Aperture or iris to regulate the exposure and to control depth of field;
2. Zoom to control the focal length and angle of view;
3. Shutter speed to regulate the exposure and to maintain desired motion portrayal;
4. Gain to amplify signal strength in low-light conditions;
5. Neutral density filters to regulate the exposure.

Imager : This is used to convert light into electric signal. The camera lens projects an image onto the imager surface, exposing the photosensitive array to light. The light exposure is converted into electrical charge. At the end of the timed exposure, the imager converts the accumulated charge into a continuous analog voltage at the imager's output terminals. After scan-out is complete, the photosites are reset to start the exposure-process for the next video frame.

Recorder : This is the third part of the *Camcorders*. The *recorder* is responsible for writing the video-signal onto a recording medium (such as magnetic videotape). The record process involves many signal-processing steps, and historically, the recording-process introduced some distortion and noise into the stored video, such that playback of the stored-signal may not keep the same characteristics/detail as the live video feed.

INTRODUCTION TO DIGITAL VIDEO COMPRESSION TECHNIQUES

Overview of Compression:

When exporting a video program, you choose a *compressor/decompressor* or *codec*, to compress the information for storage and transfer (such as on a DVD) and to decompress the information so it can be viewed again. Compressing the video program makes it play smoothly on a computer. A wide range of codecs is available; no single codec is the best for all situations. For example, the best codec for compressing cartoon animation is generally not efficient for compressing live-action video.

There are two main organizations that develop image and video compression standards: International Telecommunications Union (ITU) and International Organization for Standardization (ISO). Formally, ITU is not a standardization organization. ITU releases its documents as recommendations, for example "ITU-R Recommendation BT.601" for digital video. ISO is a formal standardization organization, and it further cooperates with International Electrotechnical Commission (IEC) for standards within areas such as IT. The latter organizations are often referred to as a single body using "ISO/IEC". The fundamental difference is that ITU stems from the telecommunications world, and has chiefly dealt with standards relating to telecommunications whereas ISO is a general standardization organization and IEC is a standardization organization dealing with electronic and electrical standards.

Now let us see" Why is Video Compression Necessary?"

Video Compression is a necessary function of Recording Video and TV signals onto a Computer Hard Drive. Because raw Video footage requires lots of space, without Video Compression, Video files would quickly eat up gigabytes of hard drive space, which would result in only short amounts of Video or TV recorded onto the Computer's Hard Drive. With Video Compression, smaller Video files can be stored on your PCs Hard Drive, resulting in much more space for Video files. In other words, Video Compression lets you store much more TV and video on your Computer than if the Video files were not compressed.

Now let us see "What is compression ?"

Definition: *"Compression is a reversible conversion of data to a format that requires fewer bits, usually performed so that the data can be stored or transmitted more efficiently."*

The size of the data in compressed form (C) relative to the original size (O) is known as the compression ratio (R=C/O). If the inverse of the process, *decompression*, produces an exact replica of the original data then the compression is **lossless**. ***Lossy compression***, usually applied to image data, does not allow reproduction of an exact replica of the original image, but has a higher compression ratio. Therefore lossy compression allows only an approximation of the original to be generated. For image compression, the fidelity of the approximation usually decreases as the compression ratio increases. Compression is analogous to folding a letter before placing it in a small envelope so that it can be transported more easily and cheaply. Compressed data, like the folded letter, is not easily read and must first be decompressed, or unfolded, to restore it to its original form.

The success of data compression depends largely on the data itself and some data types are inherently more compressible than others. Generally some elements within the data are more common than others and most compression algorithms exploit this property, known as ***redundancy***. The greater the redundancy within the data, the more successful the compression of the data is likely to be. Fortunately, digital video contains a great deal of redundancy and thus is very suitable for compression.

A device (software or hardware) that compresses data is often know as an ***encoder*** or ***coder***, whereas a device that decompresses data is known as a ***decoder***. A device that acts as both a coder and decoder is known as a ***codec***. A great number of compression techniques have been developed and some lossless techniques can be applied to any type of data.

Now let us see" What is a codec?"

A *codec* is software that is used to compress or decompress a digital media file, such as a song or video. Content creators use codecs because a compressed file takes up less storage space on your computer and can be transferred across the Internet more quickly and smoothly. When you play a digital media file, Windows Media Player uses a codec to decompress the file. *Codecs* are used to create and play nearly all music or video files on your computer or on Web sites.

A *codec* can consist of two components—an encoder and a decoder. The encoder compresses a file during creation, and the decoder decompresses the file so that it can be played. Some codecs include both components, while other codecs only include one. For example, if you install a DVD playback program on your computer, the program will likely install a codec that only includes an MPEG-2 decoder, which allows you to play the DVD on your computer. You would not be able to use the decoder to create your own DVD.

Compression Latency:

Now let us see" What is Compression Latency?"

The compression process involves one or several mathematical algorithms that eliminate image data. When the video is to be viewed other algorithms are applied to interpret the data and view it on the monitor. Those steps will take a certain amount of time. That delay is called **compression latency**. When using video compression and several adjacent frames are being compared in the compression algorithm, more latency is introduced. For some applications, like compression of studio movies, compression latency is irrelevant since the video is not watched live. In urveillance and security using live monitoring, especially when PTZ and dome cameras are being used, low latency is essential.

TYPE OF DIGITAL VIDEO COMPRESSION TECHNIQUES:

Compression techniques used for digital video can be classified into three (3) main groups:

1. General purpose lossless compression techniques can be used for any kind of data.
2. Intraframe compression techniques work on images.
3. Interframe compression techniques work on image sequences rather than individual images.

1. General Purpose lossless Compression Techniques:

There are many well-liked general purpose ***lossless compression techniques***, which can be applied to any type of data.

Run Length Encoding : *Run Length Encoding* is a compression technique that replaces repeated occurrences of a symbol with the symbol followed by the number of times it is repeated. For example, the string 111110000003355 could be represented by 15063252. Without a doubt

this compression technique is most useful where symbols appear in long runs, and thus can sometimes be useful for images that have areas where the pixels all have the same value, cartoons for example.

Relative Encoding : *Relative encoding* is a transmission technique that tries to get better efficiency by transmitting the difference between each value and its predecessor, in place of the value itself. Thus the values 15106433003 would be transmitted as 1+4-4-1+6-2-1+0-3+0+3. In effect the transmitter is predicting that each value is the same as its predecessor and the data transmitted is the difference between the predicted and actual values. Differential Pulse Code Modulation (DPCM) is an example of relative encoding.

Huffman Coding : *Huffman coding* is a well-liked compression technique that assigns variable length codes (VLC) to symbols, so that the most frequently occurring symbols have the shortest codes. On decompression the symbols are reassigned their original fixed length codes. When used to compress text, for example, variable length codes are used in place of ASCII codes, and the most common characters, usually *space*, *e*, and *t* are assigned the shortest codes. In this way the total number of bits required to transmit the data can be considerably less than the number required if the fixed length representation is used. Huffman coding is particularly effective where the data are dominated by a small number of symbols.

Arithmetic Coding : Although Huffman coding is very efficient; it is only optimal when the symbol probabilities are integral powers of two. Arithmetic coding does not have this restriction and is generally more efficient than the more popular Huffman technique. Though more efficient than Huffman coding, arithmetic coding is more complex.

Lempel-Ziv Coding : Lempel-Ziv compressors use a dictionary of symbol sequences. When an occurrence of the sequence is repeated it is replaced by a reference to its position in the dictionary. There are several variations of this coding technique and they differ primarily in the manner in which they manage the dictionary. The most well known of these techniques is the Lempel-Ziv-Welch variation.

2. Intraframe Compression Techniques:

Intraframe compression is compression applied to still images, such as photographs and diagrams, and exploits the redundancy within the image, known as *spatial redundancy*. Intraframe compression techniques can be applied to individual frames of a video sequence.

Sub-sampling

It is the most fundamental of all image compression techniques and it reduces the amount of data by throwing some of it away. Sub-sampling reduces the number of bits required to describe an image, but the quality of the sub-sampled image is lower than the quality of the original. Sub-sampling of images usually takes place in one of two ways. In the first, the original image is copied but only a fraction of the pixels from the original are used. On the other hand, sub-sampling can be implemented by calculating the average pixel value for each group of several pixels, and then substituting this average in the appropriate place in the approximated image. The latter technique is more complex, but generally produces better quality images.

Coarse Quantization : Coarse quantization is similar to sub-sampling in that information is discarded, but the compression is accomplished by reducing the numbers of bits used to describe each pixel, rather than reducing the number of pixels. Each pixel is reassigned an alternative value and the number of alternate values is less than that in the original image. In a monochrome image, Figure 2.4a for example, the number of shades of grey that pixels can have is reduced. Quantization where the number of ranges is small is known as *coarse quantization*.

Transform Coding : *Transform coding* is an image conversion process that transforms an image from the spatial domain to the frequency domain. The most popular transform used in image coding is the Discrete Cosine Transform (DCT). Because transformation of large images can be prohibitively complex it is usual to decompose a large image into smaller square blocks and code each block separately.

Instead of representing the data as an array of 64 values arranged in an 8x8 grid, the DCT represents it as a varying signal that can be approximated by a collection of 64 cosine functions with appropriate amplitudes. The DCT represents a block as a matrix of coefficients.

The most useful property of DCT coded blocks is that the coefficients can be coarsely quantized without seriously affecting the quality of the image that results from an inverse DCT of the quantized coefficients. It is in this manner that the DCT is most frequently used as an image compression technique.

3. Interframe Compression Techniques:

Interframe compression is compression applied to a sequence of video frames, rather than a single image. In general, relatively little changes from one video frame to the next. Interframe compression exploits the similarities between successive frames, known as temporal redundancy, to reduce the volume of data required to describe the sequence.

There are several interframe compression techniques, of various degrees of complexity, most of which attempt to more efficiently describe the sequence by reusing parts of frames the receiver already has, in order to construct new frames.

Sub-sampling : Sub-sampling can also be applied to video as an interframe compression technique, by transmitting only some of the frames. Sub-sampled digital video might, for example, contain only every second frame. Either the viewer's brain or the decoder would be required to interpolate the missing frames at the receiving end.

Difference Coding : Difference coding, or conditional replenishment, is a very simple interframe compression process during which each frame of a sequence is compared with its predecessor and only pixels that have changed are updated. In this way only a fraction of the number of pixel values is transmitted.

If the coding is required to be lossless then every changed pixel must be updated. There is an overhead associated with indicating which pixels are to be updated, and if the number of pixels to be updated is large, then this overhead can adversely affect compression.

INTRODUCTION TO VARIOUS DIGITAL VIDEO FILES FORMATS:

Now Let us take a look at some of the more popular video formats.

1. AVI
2. MPEG
3. DV
4. MOVE Real Video

1. AVI (Audio Video Interleave) :

Now let us see" What is AVI?"

AVI stands for Audio Video Interleave. It is the original Microsoft file format for Microsoft's Video for Windows standard.

Definition: *"AVI is a special case of the RIFF (Resource Interchange File Format) that is defined by Microsoft. It is the most common format for audio/video data on the PC."*

It is an audio video standard designed by Microsoft. It is a format developed for storing video and audio information. Files in this format have an .AVI extension. However, Video for Windows does not require any special hardware, making it the lowest common denominator for multimedia applications.

2. MPEG(Motion Picture Experts Group)

Now let us see" What is MPEG?"

Definition: *"MPEG (Motion Picture Experts Group) is a file format that compresses video files effectively. It gives excellent compression with little loss in quality of the video."*

MPEG supports three types of data - video, audio and streaming. There are a number of standards: among them there are two flavors of MPEG available today. MPEG-1 was designed to provide VHS video quality and CD audio quality at a combined data rate of 150 kilobytes per second. MPEG-1 is displayed at 30 frames per second in a frame that is 352x240 (horizontal x vertical) pixels in size. This allows relatively high quality video images to be stored in relatively small file sizes for playback across computer networks or CD-ROM delivery. MPEG-2 is the other side of the compression coin. It is a broadcast standard specifying a playback size of 720 x 480 pixels at 60 fields per second. Data rates can range from 2 to 10 megabits per

second. This means large file sizes and data rates that require specialized hardware for playback. MPEG-2 is one of the core compression technologies for DVD. The major advantage of MPEG compared to other video and audio coding formats is that MPEG files are much smaller for the same quality. This is because MPEG uses very sophisticated compression techniques. You can create MPEG video using the Adobe Media Encoder; any video you export to DVD is automatically transcoded to MPEG if it isn't already in that form.

MPEG-1 is most efficient between 1-2.5Mbps and is usually encoded at quarter-screen resolution (352×240) and at 30fps. It's generally zoomed up to fullscreen when decoded to a video monitor. Image quality was designed to be "better than VHS tape," and MPEG-1 can still look good today if there isn't much motion or complexity in the footage.

MPEG-2 is the video standard for DVDs and digital television. It is generally encoded at full resolution (720×480) and at 60 fields per second. MPEG-2 is most efficient between 3-9Mbps, although it can be used at higher HD resolutions and at higher bit rates with different "profiles."

MPEG-4

MPEG-4 is a video standard defined by the Moving Picture Experts Group (MPEG) Many developers around the world contributed to MPEG-4 in the late 1990s and the format became an international standard in 2000.it ISO/IEC open standard for video encoding developed by MPEG (Moving Picture Experts Group). It is characterized by a small output video file size and quite good picture quality even when a relatively low bit rate is used. The most known resulting output when you use MPEG-4 format for compression is the AVI file type which is commonly used in home video. It is coded with Xvid, DivX, 3ivx, Nero Digital and other video codecs. MPEG-4 is supported by a variety of players.

3. DV (digital video):

Definition: *"DV is the digital video standard for consumer and lower-end professional camcorders. It's an intraframe variation of Motion-JPEG"*

However DV is not an inter*frame* technique, DV does use inter*field* compression to exploit the temporal redundancies between the two fields that make up a single interlaced video frame. Somewhat confusingly, DV is a video compression format but is associated with tape formats bearing similar names. The DV video compression is consistent, but the tapes are not. MiniDV is the most common tape format — it's used in consumer camcorders and a number of lower-end professional camcorders. In an effort to maintain a distinction (and higher sales margins) between their consumer and professional products, Sony and Panasonic offer "professional" tape formats — DVCAM and DVCPRO, respectively. The video compression doesn't change, but the larger tape formats do afford greater redundancy for error protection, as well as additional audio support. More confusingly, each manufacturer also has higher-bit-rate versions of DV, including Panasonic's DVCPRO50, DVPCRO100 (DVCPRO HD), and Sony's HDCAM.

EXERCISE

1. What is digital video ? How it differ from analyg video ? Explain with suitable diagram.
2. Explain frame rate and fields. How many way you can present frame ?
3. Explain various video effects.
4. What is transform effect ? Explain various types of transform effects.
5. How do you use video on PC ? Explain.
6. What are graphics accelerator cards ? What are characteristics of graphics accelerator cards ?
7. What is directX ? What are the various API of directX ? Explain.
8. What are Analog Video/Digital Video (AV/DV) cards ? Explain.
9. What is IEEE 1394 (firewire) card ? How do you capture video using an IEEE 1394 device? Write all steps.
10. What is digitization of video ? Explain ADC.
11. What is interlacing and non-interlacing ? Explain interlaced and Non-interlaced video.
12. Explain important video file format. How does streaming video work ?
13. What are differences between Lossy and Lossless Compressions ? Explain.
14. What are NTSC and PAL broadcasting standard ? Explain.
15. What is PAL ? What are the various variations of PAL ? Explain.
16. What do you mean by SECAM ? What are the various variations of SECAM ? Explain.
17. What is HDTV ? What are differences between SDTV and HDTV ? What are the minimum performance attributes of HDTV ? Explain.
18. What is VCD ? What are the advantages of VCD over DVD video ? Explain.
19. What is magnetic tape ? Why do you use it for backup ? Explain.
20. What is DVCAM ? What are the salient features of DVD Handycam ?
21. What is camcorder ? What are major components of a camcorder ? Explain.
22. What is compression ? Why is video compressions necessary ? Explain codec.
23. What is compression latency ? Explain various types of digital video compression techniques.
24. Write short note on the following :
    (i) AVI (ii) MPEG (iii) DV (iv) PAL
25. Explain the following :
    (i) NTSC (ii) HDTV (iii) PAL (iv) SECAM