CHAPTER

2 Taxonomy of Multimedia Objects

After completing this chapter, you will be able to:

- **Define and recognize linked objects in a multimedia application**
- **Understand the present-day limits of creating those objects**
- **Think about what new kinds of objects there may be in the future as multimedia technology progresses**
- **Consider whether the digitization of media is making communication better or worse, and understand the appropriate role of technology**

The definition of multimedia in the previous chapter emphasizes the important role that links play in giving users a way to interact and navigate. This chapter defines the objects of those links by providing a taxonomy of multimedia. There are six kinds of objects: text, graphics, sound, video, animation, and software. The roles each kind plays in a multimedia system are described here.

Text

Although it is possible to have multimedia without text, most multimedia systems use text because it is such an effective way to communicate ideas and provide instructions to users. There are four kinds of text: printed, scanned, electronic, and hypertext.

Printed Text

Printed text, like the words in this paragraph, appears on paper. Suppose you want to use printed text as the basis for a multimedia document. In order for a multimedia computer to read printed text, you need to transform the text into machine-readable form. The most obvious way to do this is to type the text into a word processor or text editor, but that is tedious and time-consuming. A faster way would be to scan the text.

Scanned Text

Low-cost scanners that can read printed text and convert it into machine-readable form to produce **scanned text** are widely available. There are three basic kinds of scanners: flatbed, handheld, and sheet-fed. Flatbed scanners are more expensive because of the motors and pulleys that move the scanner over the paper. Handheld scanners cost less because you move the scanner over the paper manually, thereby avoiding the cost of the flatbed enclosure and mechanism. Sheet-fed scanners have a slot into which you insert the page you want scanned. Regardless of the kind of scanner you have, advances in the optical character recognition (OCR) software that comes with scanners have increased scanning accuracy.

USA TODAY · FRIDAY, JULY 1, 1994 · 9B

IDYEAR

Top trend so far: More big mergers

Deals have made a roaring comeback on Wall Street. Thursday alone, Nynex and Bell Atlantic said they'd merge their cellular phone operations; Burlington Northern and Santa Fe Pacific are teaming up in a $2.7 billion deal; and CBS says it's talking to QVC about a merger *(stories, 1B, 2B, 3B)*. The total value of mergers and acquisitions announced this year has ballooned to $117.7 billion compared with $99 billion the first half of last year. If the pace keeps up, 1994 could be the biggest year for M&A since 1989, the peak of the 1980s merger frenzy.

Why is M&A activity so hot? Strategic moves are behind the flurry of deals, analysts say. Companies are trying to add to market share or cut costs by selling a division or teaming up with a competitor. And interest rates, though rising, are still relatively low. That makes it cheap for companies to borrow for deals.

"We'll see a tremendous amount of activity the second half of the year," says Martin Sikora, editor of *Mergers & Acquisitions* magazine. The biggest deals have been in defense, health care, banking and telecommunications industries. Activity also has been hot in areas such as computer software, auto parts, business services and environmental companies.

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Megadeals of '94

Biggest deals announced so far this year:

Buyer	Target	Price (billions)
Viacom	Blockbuster	$7.9
Roche Holding	Syntex	$5.3
Sandoz	Gerber	$3.7
Burlington Northern	Santa Fe Pacific	$2.7
Conseco	Kemper	$2.7

Figure 2-1 A newspaper article from *USA TODAY*. Copyright 1994, USA TODAY. Reprinted with permission.

Figure 2-2 The newspaper article being scanned with a handheld scanner.

For example, consider the newspaper article in Figure 2-1. Figure 2-2 shows it being scanned by a handheld scanner. You can see the results of the scan in Figure 2-3. Notice how a couple of characters have a caret (^) in front of them. The scanning software marks characters with a caret when it is not sure whether it has accurately recognized them. If you compare Figure 2-3 to the original text in Figure 2-1, however, you will see that every character is correct.

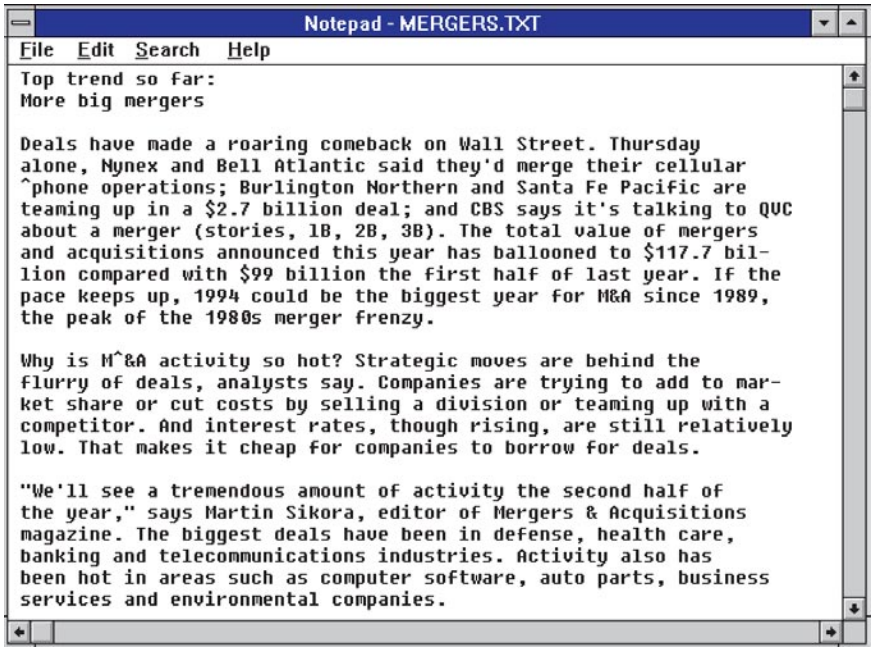

Figure 2-3 The results of the scan. The caret (^) marks characters about which the scanner was unsure.

The author used a handheld scanner extensively while writing this book. Instead of typing quotes from books and magazines, the author simply swiped the scanner over the quotes and flowed the scanned text into this document. As this book goes to press, the most portable scanner is the IRISPen, which is a pen-sized scanner that allows you to scan text into any Windows or Macintosh application. It scans editable text into the current cursor position. For more information, follow the *Multilit* Web site links to handheld scanners.

Electronic Text

A tremendous number of texts are available in machine-readable form, because almost everyone who writes books or publishes manuscripts today does so with word processing and electronic publishing equipment. Because they can be read by a computer and transmitted electronically over networks, such texts are referred to as **electronic texts**. For example, this book was written with Microsoft Word 2000.

Electronic text was used extensively in writing this book. Internet news feeds and other networked resources provided a rich store of information that would otherwise have taken years to research. You will learn how to access these news feeds in the online resources section of Chapter 17.

Hypertext

The prefix *hyper* may be the most important word in this book, because it refers to the process of linking, which makes multimedia interactive. The word *hypertext* was coined by Ted Nelson (1965). **Hypertext** refers to text that has been linked. When you view a hypertext and click a word that has been linked, your computer launches the object of that link. Any one of the objects listed in this taxonomy of multimedia can be the object of such a link. The links give the text an added dimension, which is why it is called hyper.

Graphics

It has often been said that a picture is worth a thousand words. However, that is true only when you can show the picture you want when you need it. Multimedia lets you do this when graphics are the object of a link. Graphics often appear as backdrops behind text to create a pictorial framework for the text. Pictures can also serve as icons, intermixed with text, representing options that can be selected; or pictures can appear full-screen in place of text, with parts of the picture serving as triggers which, when selected, launch other multimedia objects or events.

Bitmaps

A **bitmap** is a picture stored as a set of pixels that correspond to the grid of dots on a computer screen. To display the picture, the computer sets each dot on the screen to the color specified for it in the bitmap. You can create bitmaps with any graphics editor, such as the Paint program that comes with Windows, or commercial drawing programs such as Adobe Photoshop or CorelDRAW. In Chapter 34, you will learn how to use Paint Shop Pro (Windows) or GraphicConverter (Macintosh) to capture into a bitmap any graphic displayed on your computer screen from any software program, including frames from live video feeds.

Over the years many different graphics formats have been invented for storing images on computers. Table 2-1 lists the most common formats and identifies their intended purpose.

Table 2-1 The Most Common Computer Graphics Formats

Filename Extension	Intended Purpose
.bmp	Windows bitmap; the BMP file is the most efficient format to use with Windows
.dib	Windows device-independent bitmap; used to transfer bitmaps from one device or process to another
.gif	Graphics Interchange Format (GIF); invented by CompuServe for use on computer networks, GIF is the prevalent graphics format for images on the World Wide Web
.mac	Macintosh MacPaint format
.jpg	JPEG image, named for the standards committee that formed it: the Joint Photographic Experts Group; intended to become a platform-independent graphics format
.pcd	Kodak's Photo CD graphics file format; contains five different sizes of each picture, from "wallet" size to "poster" size
.pcx	Zsoft Paintbrush graphics format; popular in the DOS world
.pic	PC Paint graphics format
.pict	The Macintosh standard image format
.png	Portable Network Graphics format. Pronounced ping, *.png* is the patent and license-free format approved by the W3C (World Wide Web Consortium) to replace the patented GIF format
.tga	Truevision Targa format; *tga* stands for Targa, which is a video capture board
.tif	Tagged Image File Format (TIFF); known as "the variable standard" because there are so many kinds of TIFF subformats
.wpg	WordPerfect graphics format

Vector Images

Vector images are stored as a set of mathematical equations called algorithms that define the curves, lines, and shapes in a picture. For images that do not contain a lot of continuous color changes, vectors are a more-efficient way to store the image than bitmaps. Consider a diagonal line, for example. A bitmap stores each point along the diagonal as an RGB color value. A vector image, on the other hand, simply stores the line's starting point, direction, length, and color.

Vector images have two advantages over bitmaps. First, vector images are scalable, meaning that you can use graphics programs to enlarge or reduce the size of the image without any loss of quality. Second, because vector images normally have smaller file sizes than bitmapped graphics, vectors download more quickly over the Internet.

AutoDesk is the leading manufacturer of vector-based software. Their AutoCAD software uses vector-based graphics to create working models of architectural and mechanical drawings. AutoDesk has created plug-ins that enable Web browsers to display vector drawings and let users interact with AutoCAD models. To download the plug-ins and manipulate some sample AutoCAD drawings, follow the *Multilit* Web site links to the AutoDesk plug-ins. For more information about vector technology and standards, follow the links to the Vector Zone.

Clip Art

Creating graphics by hand is time-consuming. To save time there are extensive libraries of clip art that you can use in multimedia productions. By following the *Multilit* Web site links to clip art, you will discover dozens of online clip libraries. Many have broad,

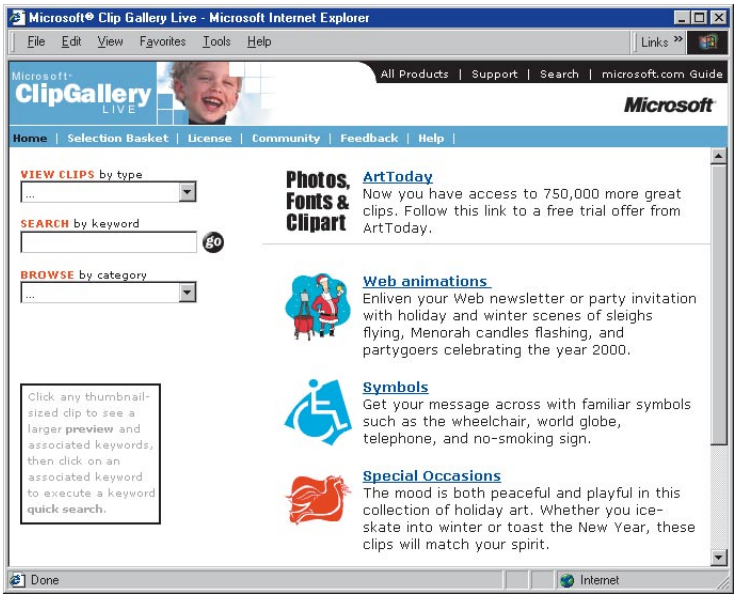

Figure 2-4 Microsoft's online clip library provides you with hundreds of thousands of royalty-free images.

general categories including photographs, icons, animations, background tiles, buttons, and bullets, while other libraries focus on a visual theme such as nature or scientific images. You can usually use clip-art images royalty free, but make sure you read the license carefully because restrictions may apply. You may be required to include a courtesy hyperlink to the clip library's Web site, for example.

In Chapter 21, you will learn how to use Microsoft's online clip library. Figure 2-4 shows how it lets you search for clip art by type, key word, or category.

Digitized Pictures

Video capture boards let you connect a video camera, VCR, videodisc player, or live video feed to your computer and grab frames instantly into bitmaps that can be used in multimedia applications. Think of the pictorial breadth this technology provides: Since video digitizers accept a video signal as input, they can digitize anything a video camera can see. Any photograph, slide, or picture from any book or magazine can be digitized in full color and linked into your multimedia application. Because copyright law prohibits unlawful copying and distribution, however, make sure you study the copyright and fair use guidelines presented in Chapter 16.

Snappy Video Snapshot is an image capture module that connects to the printer port on the back of a desktop or laptop PC. Snappy can capture images up to 1500 × 1125 pixels with up to 16 million colors. Since you do not have to put anything inside your computer, Snappy is much easier to install than a video capture card. You should be aware, however, that Snappy does not capture full-motion movies like video capture boards do; Snappy just does what its name implies, which is to "snap" still pictures from the output of a video camera or other video source. For more information, follow the *Multilit* Web site links to Snappy.

Figure 2-5 The e-photo Web site for Eckerd Drugs.

Courtesy of Eckerd Corporation; Kodak is a registered trademark of Eastman Kodak Company, and PhotoNet is a registered trademark of PictureVision Inc. Copyright 1996–2000.

Figure 2-6 Kodak PhotoNet online.

Courtesy of Eckerd Corporation; Kodak is a registered trademark of Eastman Kodak Company, and PhotoNet is a registered trademark of PictureVision Inc. Copyright 1996–2000.

If you do not have a capture board or a Snappy, you can shoot a roll of film and take it to a mass market retail store, such as Eckerd Drugs, where it only costs about $4 extra to get a diskette with up to 15 pictures, $5 for up to 28 images, and $6 for 29 or more exposures. The diskette has software that lets you view the pictures on your PC and export the images in different graphics formats.

Figure 2-5 shows Eckerd's e-photo Web site. Clicking the link to online photo services takes you to Kodak PhotoNet online, as illustrated in Figure 2-6. How this works is fascinating. You take your film to any participating Eckerd drugstore and request Kodak PhotoNet online by simply checking the appropriate box and providing your e-mail address. You will receive an e-mail message notifying you when your negatives and prints are ready to be picked up and how you can access your scanned photos online. Digital camera users have the option of creating a free online account and purchasing a "roll of space" into which you can upload photos and place an order for high-quality prints.

For more information about digital photo processing and to preview the Kodak PhotoNet online gallery, follow the *Multilit* Web site link to the Eckerd drugstore e-photo digital image center. For the latest information about digital cameras, click the *Multilit* Web site's digital camera link.

Hyperpictures

Just as words can serve as triggers in a hypertext, so also can parts of pictures. When parts of pictures are used to trigger multimedia events, they are called **hyperpictures**. In Chapter 23, you will learn how to make any part of any image be a trigger that you can link to any text, graphic, sound, or video on your computer, or to any Web page or other multimedia resource on the Internet. The triggers can be any size or shape, and you can make them invisible. There is no limit to the number of triggers you can put on a hyperpicture. When the user mouses over a trigger, the cursor changes shape to tell the user that spot is a hyperlink. If the user clicks there, your link will trigger.

Sound

There are four types of sound objects that can be used in multimedia productions: waveform audio, MIDI sound tracks, compact disc (CD) audio, and MP3 files.

Waveform Audio

Just as video digitizers can be used to grab any picture a camera can see, **waveform audio** digitizers can record any sound you can hear. Every sound has a waveform that describes its frequency, amplitude, and harmonic content. Waveform audio digitizers capture sound by sampling this waveform thousands of times per second; the samples are stored on a computer's hard disk in a file that usually has a *.wav* filename extension, which stands for waveform. Figure 2-7 shows a waveform in the process of being sampled, and Figure 2-8 shows the samples from the corresponding *.wav* file.

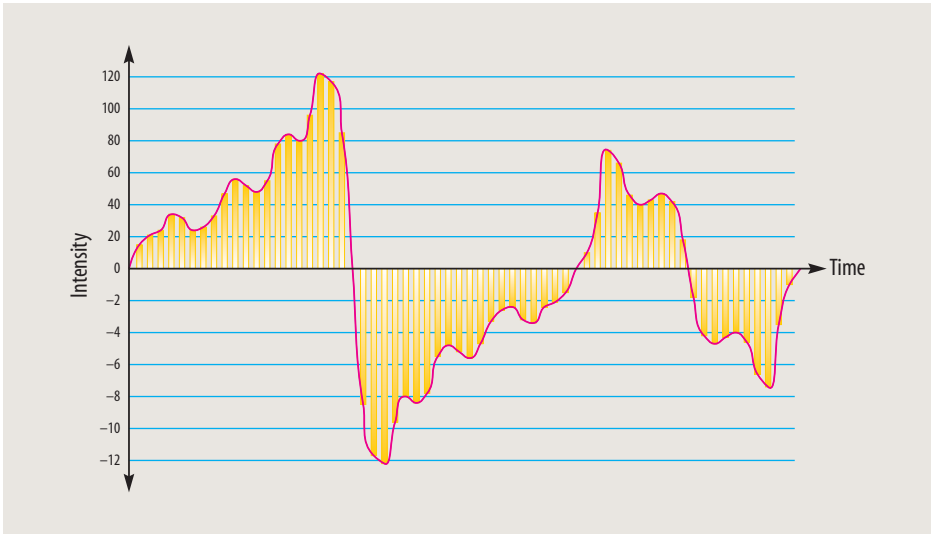

Figure 2-7 Waveform in the process of being sampled; the vertical lines show the points at which samples are taken.

0	33	80	–122	–56	–21	40	–43
15	47	96	–96	–47	–15	43	–40
21	56	122	–80	–33	0	47	–46
24	52	117	–84	–26	10	42	–66
34	48	85	–78	–24	35	18	–74
32	55	0	–55	–32	74	–18	–35
24	78	–85	–48	–34	66	–42	–10
26	84	–117	–52	–24	46	–47	0

Figure 2-8 Samples taken from the waveform in Figure 2-7.

The *Multilit* Web site provides links to Web sites offering free, downloadable waveform audio in a wide range of genres including contemporary and classical music, movie soundtracks, television programs, and sound effects. Read the license carefully because restrictions may apply, especially if you are planning to charge a fee for the application in which you use the clip.

MIDI

MIDI stands for Musical Instrument Digital Interface. It provides a very efficient way of recording music. Instead of recording the waveform of the sound, which requires a lot of storage, MIDI records the performance information required for your computer's sound chip to play the music. For example, there are MIDI codes for turning notes on and off, making them loud or soft, changing their timbre or tone quality, and bending them or adding other special effects. MIDI files have a *.mid* filename extension. They can be randomly accessed down to an accuracy of 1/128 second.

The MIDI folder on the *Multilit* CD contains several MIDI songs that were provided courtesy of Midisoft Corporation. In addition, the *Multilit* Web site provides links to MIDI archives where you can download thousands of MIDI songs from the Internet. As always, read the license carefully and observe the copyright and fair use guidelines presented in Chapter 16.

Audio CD

Audio CDs can hold up to 75 minutes of high-fidelity recorded sound. The sampling rate is 44,100 samples per second, which is fast enough to record any sound audible to humans. The samples are 16 bits, producing a dynamic range of 98dB, which is discrete enough to record faithfully a quiet whisper or a loud scream. The addressing used in CD-ROM drives permits multimedia computers to randomly access a song on the CD with split-second accuracy down to 1/75 of a second.

In Chapter 24, you will learn how to make any track or sound clip play from an audio CD during a multimedia presentation. At the *Multilit* Web site, you will find links to CD audio stores where you can find just about any song in the world, from your favorite recording artist to that hard-to-locate classical recording. There is even a link to a custom disc company that will burn a one-of-a-kind CD containing just the songs you want.

CD Plus, CD Extra, and Enhanced CD

CD Plus, also known as **CD Extra** or **Enhanced CD**, is a music CD that can also function as a CD-ROM, with computer data included on the music disc. If you put the CD Plus into a conventional audio CD player, you hear the music as usual. Insert the CD Plus into a multimedia PC, and the computer programming provides you with dazzling computer graphics, navigation, and interactivity.

To find out whether an audio CD has these features, put it in your computer's CD or DVD drive, and wait to see if an enhanced window pops up offering you a menu of extra features on the CD.

MP3

MP3 stands for MPEG Audio Layer 3. It is an audio file format that uses an MPEG audio codec to encode (compress) and decode (decompress) recorded music. MP3 can compress a CD audio track into a substantially smaller sized file requiring

significantly less bandwidth to transmit over the Internet without degrading the original sound track's quality.

To download a free MP3 player, find MP3 Web sites, and create MP3 files from your favorite audio CD, follow the *Multilit* Web site links to MP3. If you do not personally own the CD, and/or if the MP3 files are not for your own personal use, please observe the copyright and fair use guidelines presented in Chapter 16. Because the MP3 technology makes it so easy to violate copyright, the kind of software used to create an MP3 file from an audio CD is called a **ripper**.

Hyperaudio

Sound tracks are played over time. Many multimedia creation tools allow you to time the occurrence of objects to sync points in the music. When audio is used to trigger multimedia objects, it is referred to as **hyperaudio**.

Video

Video provides a rich and lively resource for multimedia applications. There are four types of video that you can use as the objects of links in multimedia applications: live video feeds, videotape, videodisc, and digital video.

Live Video Feeds

Live video feeds provide interesting real-time objects of multimedia links. Any television channel or live camera feed can be the object of a link. Suppose you are teaching civics and you want to illustrate how a bill works its way through Congress. C-SPAN, the Cable-Satellite Public Affairs Network, operates one channel that covers proceedings on the floor of the House of Representatives, and another channel devoted to the Senate; it also broadcasts interviews and call-in shows, congressional hearings, speeches, and press conferences.

If you teach a subject in which current events are important, your multimedia software can put you just a mouse click away from CNN, the 24-hour news channel that summarizes the news every 30 minutes. Or suppose you are a plant supervisor needing to inspect what is happening on one of your assembly lines; a mouse click can instantly display a live video feed on your multimedia computer screen.

Webcams let you watch live video feeds from all over the world. From freeway traffic to surfing beaches, day care centers to college dorm rooms, Webcams can be found just about anywhere. For a look at some of the more popular Webcams, follow the *Multilit* Web site links, where you will find articles about Webcam use and a search engine that indexes more than 11,000 cameras.

Videotape

The most widespread video medium is videotape. Almost everyone owns a VCR, and nearly every shopping center has a video store that rents movies on videotape. Corporations use videotape to provide just-in-time training, and public libraries have collections of instructional videotapes.

Videotapes can be the object of multimedia links. This medium is limited by two factors, however. First, videotapes are linear. The information is stored on tape in a serial

fashion, and in order to access it you may have to wait a long time for the tape to fast-forward or rewind to the spot you want; this can take as long as three minutes. Second, most videotape players are not computer controllable. This means that you must manually press the *play, stop, fast-forward,* and *rewind* buttons yourself to use videotape in a multimedia presentation. Happily, Sony Hi8 videotape players are computer controllable, through a protocol called the Video System Control Architecture (VISCA), which can control up to seven devices. A wide range of Sony video products are VISCA controllable, including camcorders, VCRs, and monitors. For more information, follow the *Multilit* Web site links to Sony and VISCA.

Videodisc

There are two industrywide formats for videodiscs: CAV and CLV. CAV discs can store up to 54,000 still frames or 30 minutes of motion video with a stereo sound track. The frames are addressed by specifying numbers from 1 to 54,000. The CAV format lets you display still frames as well as play motion sequences.

CLV discs can store up to an hour of video on each disc side, which is twice as much video as CAV discs hold. But unless you have an expensive high-end player such as the Pioneer LD-V8000, you cannot show still frames from CLV discs.

Because of its fast random access and minimal consumption of the multimedia computer's resources, videodisc became one of the most popular twentieth-century means of providing video to multimedia applications in education, government, and industrial training. The popularity of videodisc has waned, however, due to the emergence of digital video and DVD, which are discussed next.

Digital Video

Digital video is the most promising and exciting video storage medium. Like waveform audio, digital video is stored in files on a hard disk, CD-ROM, or DVD. Because the video is digital, it can be served over computer networks, alleviating the need for videotapes and videodisc players. Digital video can be randomly accessed by frame, letting you play specific clips.

High-speed Pentium processors can play full-screen video without needing any special hardware installed. Slower computers need to have digital video boards installed to play movies full-screen. Otherwise, the video plays back in a window about one-quarter the size of the screen. Chapter 24 will teach you how to insert, size, and position movies. In Chapter 35, you will learn how to edit digital video and create movie clips.

DVD

DVD stands for digital versatile disc, but when a DVD's purpose is to play back a movie, it can more properly stand for digital video disc. DVD uses MPEG-2 to compress a full-length feature film onto a 4.7-inch disc. The movie plays back beautifully, with surround sound and 540 horizontal lines of full-color video. It is common for a DVD to offer the viewer a choice of languages, with or without subtitles, and sometimes the user can choose to view alternate endings to a movie. All this combined with backward-compatibility that lets you play audio CDs has led to the DVD player becoming a hot consumer item. Just as CD audio provided multimedia developers with split-second access to practically all recorded music, so also does DVD promise to create a digitally accessible store of all feature movies. Follow the *Multilit* Web site links to DVD news, reviews, and buying guides.

Hypervideo

Like sound tracks, video clips are played over time. Many multimedia creation tools allow you to time the occurrence of objects to sync points in the video. When video is used to trigger other multimedia events, it is referred to as **hypervideo**.

Animation

In multimedia, **animation** is the use of a computer to create movement on the screen. There are four kinds of animation: frame, vector, computational, and morph.

Frame Animation

Frame animation makes objects move by displaying a series of predrawn pictures, called frames, in which the objects appear in different locations on the screen. If you think about how a traditional movie plays in a theater, you can understand how frame animation works. In a movie, a series of frames moves through the film projector at about 24 frames per second. You see movement on the screen because each frame contains a picture of what the screen should look like at the moment that frame appears. Why 24 frames per second? Because that is the threshold beneath which you would notice flicker or jerkiness on the screen.

Vector Animation

A vector is a line that has a beginning, a direction, and a length. **Vector animation** makes objects move by varying these three parameters for the line segments that define the object. Macromedia is the industry leader in vector-based animation software. Macromedia's Flash software uses vector graphics to create animations and interactive graphics for use on the Web. Macromedia has published the Flash file format *(.swf)* as an open standard. For more information, follow the *Multilit* Web site links to Macromedia Flash, where you can visit a gallery of Web pages containing Flash animations and download Flash for a free 30-day trial period.

Computational Animation

Suppose you want to move a word across the screen. There are two ways to do that. You could create a series of frames that show the word inching its way across the screen, with each frame representing one moment in time as the word moves. But this would be inefficient, because the frames consume precious memory, and it takes a lot longer for an artist to draw the frames. In **computational animation**, you move objects across the screen simply by varying their x and y coordinates. The x coordinate specifies the horizontal position of the object, that is, how far across the screen. The y coordinate specifies the vertical position, that is, how far down the screen.

Morphing

Morphing means to transition one shape into another by displaying a series of frames that creates a smooth movement as the first shape transforms itself into the other shape. For example, Figure 2-9 shows the *David* morphing into the *Mona Lisa*. You can run this example on the *Multilit* CD. To run it, use the Windows Explorer or the Macintosh Finder to display the contents of the *Movies* folder, then double-click the movie named

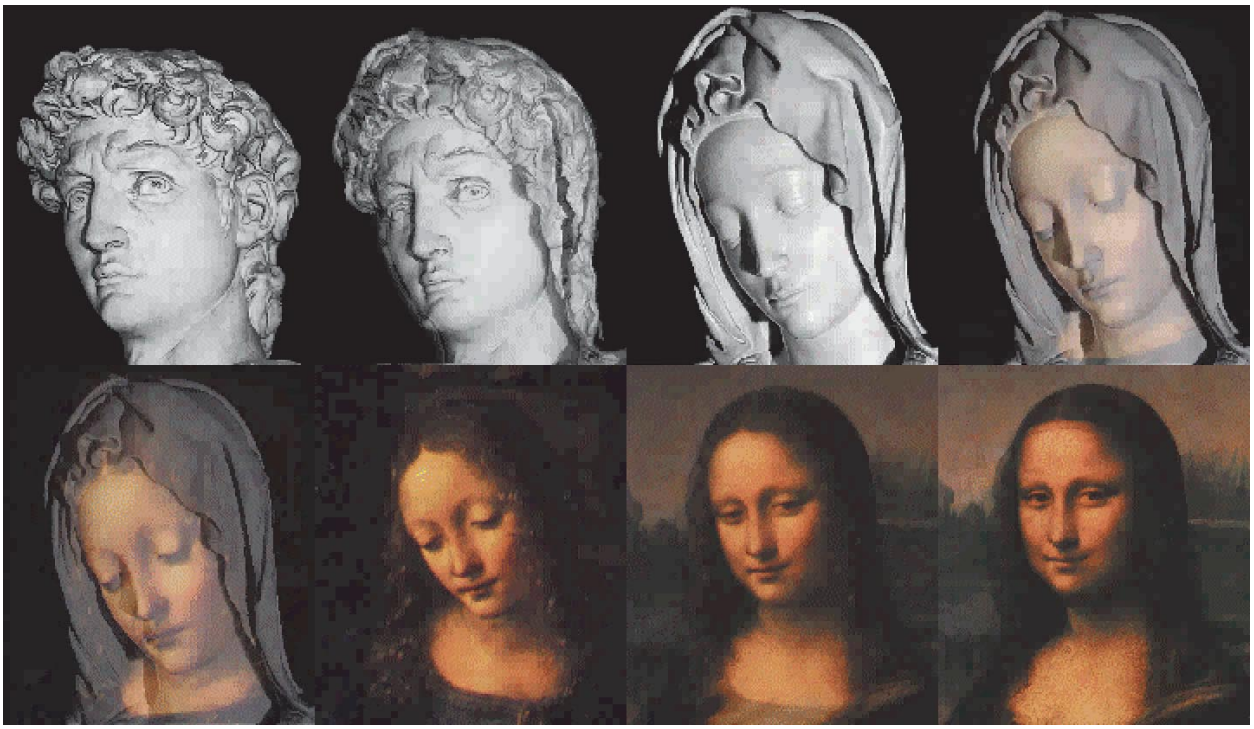

Figure 2-9 *David* morphs into the *Pieta,* then into *The Virgin of the Rocks,* and finally into the *Mona Lisa.*

morph. It would take a lot of time and patience to create a morph like this by hand. Morphing software creates the transitional frames automatically. Morphing is discussed in more depth in Chapter 5 in the section on cinematic special effects.

Software and Data

One of the most powerful concepts in multimedia is the seamless integration you can achieve by creating links to documents and datasets. When a user triggers a link to a word-processed document, such as a Microsoft Word *.doc* file for example, your computer automatically launches the software application (MS Word in this example) and uses it to display the document. Similarly, a link to an Excel spreadsheet's *.xls* file makes your computer launch Excel to display the spreadsheet. In Chapter 23 you will learn how to make these kinds of links to software and data objects.

Finding Multimedia Resources on the World Wide Web

The World Wide Web is a rich resource for finding multimedia objects of all types. In Chapter 33 you will learn strategies for locating objects via key word or subject-oriented searching. Web searches provide quick and easy access to millions of text documents, statistical datasets, pictures, sound tracks, musical scores, movies, animations, multimedia utilities, Web page creation tools, and software applications of all types. You will learn how to download these objects to your computer for use in your multimedia applications. You will also learn the proper bibliographic form for citing online resources in term papers and scholarly publications.

exercises

1. Scan a newspaper article into your word processor. Compare the scanned text to the original. How accurate was the scan? What hardware did you use to do the scan? What software? What problems do you see in scanner technology? *Note:* If you do not have a scanner, visit your local computer lab to complete this assignment.

2. Get a friend to take your picture with a 35mm camera. Have your friend zoom in close, taking the picture portrait style. Take the film to Eckerd drugstore and get it developed with the option to have a diskette returned along with your slides or prints. Run the software on the disk you get back from Eckerd, and see if your photo looks OK. What impresses you, and what disappoints you about your appearance on-screen? In Chapter 34 you will learn imaging techniques that can improve the look of your photo.

3. Printed books do not have hypertext ability. Do you believe that hypertext makes documents so powerful as to render printed books obsolete? If so, what kinds? All books, or just certain kinds? For example, is hypertext more important in an encyclopedia than in a novel?

4. Digital audio and video make it possible to digitize anything you can see or hear and edit it seamlessly, without leaving a trace. For example, a *New York Newsday* cover photograph showed ice skaters Nancy Kerrigan and Tonya Harding practicing together when in fact they were not (*New York Times* 2/17/94: A12). Will this capability make it increasingly difficult for judges in courtroom trials to admit audio recordings and videotapes into evidence?

5. Insert some audio CDs into your computer's CD or DVD drive. List the CDs you try. Do any of the CDs pop up a window that lets you access enhanced features on the CD? If so, name the CD that is enhanced, and tell what the enhanced features let you do that a plain audio CD does not. *Note:* Do not confuse the enhanced window with your computer's audio CD player. If an audio CD is not enhanced, your computer will probably pop up the CD audio player. What you are looking for in this exercise is an enhanced window that lets you do more than just play the music on the CD.

6. As multimedia technology progresses, the list of objects in the taxonomy this chapter presents will increase. Can you think of any new kinds of objects that have already been invented? How about the future? Dream up and describe a new multimedia object that future technology could support.