11

Multimedia Computer Components

After completing this chapter, you will be able to:

■ **Recognize the components of a multimedia computer**

■ **Understand the shopping terminology needed to make intelligent choices when purchasing a multimedia computer**

■ **Know the difference between a mouse and a trackball, 8-bit and 16-bit audio, analog and digital video, CD-ROM and DVD, modems and network cards, flatbed and handheld scanners, and inkjet and laser printers**

■ **Understand the data communication terminology needed to procure equipment for connecting your multimedia computer to the Internet**

● There are five categories of components in a multimedia computer: the system unit, multimedia accessories, read/write storage, auxiliary input devices, and communication options. Understanding these components will enable you to follow the multimedia computer checklists provided in Chapter 12.

System Unit

At the heart of every computer is the central processor, which is the "brain" in which computations are performed. The system unit includes the central processor and the electronics required to support it. System units normally ship with a color monitor and a pointing device.

Central Processor

The **central processor** has a numerical name that indicates the basic type and speed of the processor. Processors from Intel, which is the largest manufacturer, have the numbers 286, 386, 486, or Pentium, which would have been called 586 had the patent office not ruled that the number could not be trademarked. Instead of calling the next generation of processors the P6 as originally planned, Intel decided to call it the Pentium Pro, because of the mass market popularity of the name *Pentium*. For the same reason, Intel named the next generation Pentium III. Figure 1-5 in Chapter 1 compares the speed of the most popular Intel central processors. For comparison ratings of the most recent Intel processors, follow the *Multilit* Web site link to the Intel iCOMP benchmark. For comparison ratings of Macintosh processors, follow the link to Macintosh benchmarks.

RAM

RAM stands for random access memory; it is the main memory at the heart of a computer in which multimedia programs execute. RAM is measured in megabytes (MB). *Mega* means million, and *byte* is the unit of measure for computer memory. A byte can hold a single character, and a megabyte can hold a million characters. **Meg** is another abbreviation for megabyte.

Because multimedia objects are big, you need a large amount of RAM to make a multimedia computer work well: 32 MB is the minimum required, but many applications need 48 MB to run well. Large programs like Windows NT require 64 MB to run well. In general, the more RAM you have, the better your multimedia applications will perform.

Color Display

Color displays are also referred to as color monitors. Measured along the diagonal, they come in screen sizes ranging from 8 to 50 inches or more. The most typical sizes range from 12 to 19 inches. Larger monitors are very expensive and normally are purchased for classrooms or boardrooms, where many people need to be able to see the display.

Independent of the number of inches is the number of **pixels** the computer can display on the monitor. The minimum number for multimedia is 640 pixels across by 480 pixels down the screen. On computer spec sheets, this is expressed as 640×480 (the number across is always printed first, followed by the number down). Other common pixel grids are 800×600, 1024×768, 1280×1024, and 1600×1200. Many Webmasters are beginning to design their pages for 800×600 screens instead of the former 640×480 minimum. Any computer you purchase today, therefore, should be able to display at least 800×600 pixels.

Equally important is the number of colors the system unit can display. Older computers with VGA (video graphics array) had 4-bit color arrays that could display only 16 colors. Computers with SVGA (super VGA) had 8-bit arrays that could display 256 colors. Any computer you purchase today should be able to display at least 16-bit color, which can display 65,536 colors. Most computers being sold today have 24-bit color, which can display more than 16 million colors.

Pointing Device

The **mouse** is the most common pointing device on multimedia computers today. In the Windows world, mice have two or three buttons; for most applications, a two-button mouse works fine. On the Macintosh, the mouse has one button. Alternatives to mice include mouse pens, which let you write with a stylus instead of dragging a mouse; trackballs, which let you spin a ball instead; and the innovative TrackPoint, which is a tiny joystick mounted in the center of the keyboard on an IBM ThinkPad notebook computer. As shown in Figures 11-1 and 11-2, you work the TrackPoint with the tip of your index finger, eliminating the need for a surface on which to run a mouse.

Expansion Ports and Slots

When you purchase a multimedia computer, you should make sure it has expandability so you can add multimedia accessories later on. Four technologies are used for adding accessories on to a computer: USB, SCSI, FireWire, and expansion slots.
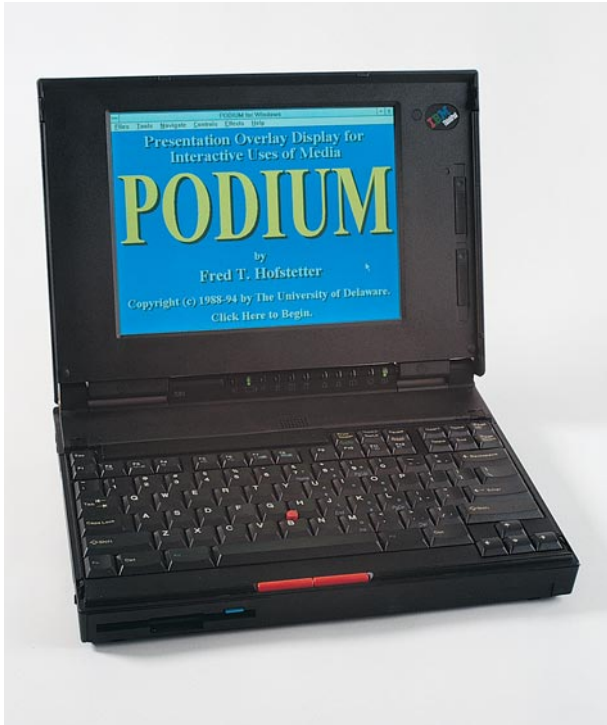
Figure 11-1 The tiny joystick in the center of this IBM ThinkPad's computer keyboard substitutes for a mouse.

Figure 11-2 A user positions the mouse cursor on the screen with the IBM TrackPoint device.

- **USB** stands for Universal Serial Bus. It is a popular way of connecting to your computer peripherals such as digital cameras, scanners, printers, fax machines, zip drives, and optical mice. One of the features users like most is the hot-swappable plug-and-play functionality of the USB port. You do not have to turn your computer off before you remove or plug in a new device. Rather, you just plug in the new device into one of your computer's USB ports, and your computer recognizes it and begins using it. You can have up to 128 USB devices installed on a computer at once. You should make sure that any multimedia computer you buy has at least two USB ports built in. If you need more down the road, you can buy an inexpensive USB splitter hub, which provides additional USB ports.

- **SCSI** stands for Small Computer System Interface. It lets you daisychain up to eight mass storage devices. Although many CD-ROM drives use SCSI, most computers do not come with an external SCSI connector to which you can attach additional SCSI devices. If your computer does not come with a SCSI connector and you need to connect a SCSI device, you will want to devote an expansion slot to installing a SCSI board. A wide range of SCSI devices are available, including internal and external hard drives, CD-ROM drives, and read/write optical drives. One of the most popular SCSI devices is the Iomega Jaz disk drive discussed in the section on multimedia read/write storage.

PCI Slots   ISA Slots

Figure 11-3 On this multimedia PC motherboard, ISA slots are outlined in blue, and PCI slots are bordered by red.

● **FireWire** is a high-speed serial technology for connecting peripherals to a computer. Originally developed by Apple, FireWire is now an official industry standard (IEEE 1394). If you are purchasing a Macintosh, make sure it has FireWire ports to which you can connect multimedia peripherals such as DV (digital video) camcorders and other high-speed devices like hard disk drives and printers.

● **Expansion slots** hold circuit cards you can plug in to add functionality to a multimedia PC. To be fully expandable, a computer needs to have at least one or two empty slots. Portable computers have slots called PC card slots. Desktop computers have slots called PCI, which stands for *Peripheral Component Interconnect*. Make sure your new computer has at least one or two empty expansion slots of each type. Desktop computers may also contain an older type of slot based on the Industry Standard Architecture (ISA), but ISA slots are slowly being replaced by the faster PCI slots, so do not be concerned if your new computer does not have ISA slots. Figure 11-3 shows a computer's motherboard that has both PCI and ISA slots.

Multimedia Accessories

Multimedia accessories give a computer the ability to make sound, play music, and record movies.

CD-ROM

By definition, multimedia computers have either a CD-ROM drive or a DVD drive that can play CD-ROMs as well as DVDs. Both are evolving technologies that keep improving. The original CD-ROM drives read computer data at a speed of 150 KB per second. Second-generation drives were twice as fast, reading data at 300 KB per second. Called double-speed or 2× speed drives, they could also read multisession CDs, which are discs that have had additional data written onto them in subsequent recording sessions. Quadruple-speed drives, also called 4× drives, transfer data at 600 KB per second. Even faster drives are available, with speeds ranging from 17× (2550 KB per second) to 40× (6000 KB per second). If you buy a computer with a CD-ROM drive, make sure it has at least a quadruple-speed drive.

DVD

A new CD-ROM format called DVD (digital versatile disc) is fast replacing CD-ROM in popularity. The DVD can hold seven times more than a conventional CD—4.7 GB (gigabytes) per layer, as compared to 680 MB for CD. Dual-layer DVDs can hold 8.5 GB on a single side, with 17 GB on a double-sided, dual-layer disc. DVD has the same diameter (120mm) and thickness (1.2mm) as a compact disc. Backward compatibility enables DVD drives to play CD-ROMs and audio CDs. For more information, including beautiful diagrams that show how DVDs are produced, follow the *Multilit* Web site link to the Sony DVD site.

Digital Audio

By definition, multimedia computers have the ability to record and play back waveform digital audio files. If your system does not have waveform audio, it is not a multimedia computer.

Figure 11-4   DeskTop Theatre 5.1 DTT 2500 Digital from Cambridge SoundWorks.

The original multimedia PC standard called for 8-bit sound, which produces a dynamic range of 50dB (decibels). Multimedia computers now also have 16-bit sound, which increases the dynamic range to 98dB. The greater the dynamic range, the more faithful the sound reproduction. For more information about the latest audio features, follow the *Multilit* Web site link to Creative Labs, the industry leader in multimedia sound.

Audio Speakers

You will need a pair of audio speakers to listen to the sound produced by your multimedia PC. If you get powered speakers with amplifiers built in, you will not need a separate amplifier. Otherwise, you will need an amplifier as well.

Sound has become so essential to multimedia that most computers come with speakers. Surround sound is an option on higher-end multimedia computers. You'll appreciate surround sound especially if you have a DVD drive, because many movies on DVD have Dolby Digital 5.1 surround sound. As illustrated in Figure 11-4, the nomenclature 5.1 refers to five surround speakers (left-front, center-front, right-front, left-rear, and right-rear) plus one subwoofer that produces low bass sounds. For more information about computer speakers, follow the *Multilit* Web site links to Boston Acoustics and Cambridge SoundWorks.

Graphics Accelerator

A **graphics accelerator** is a computer chip that helps your PC process the specialized calculations that 3D imaging requires. Graphics accelerators have memory called video RAM, which is measured in megabytes. In general, the more video RAM the graphics accelerator has, the faster it will work, and the more it will cost. If you plan to play the latest interactive games or use applications that do 3-D rendering, you will need a graphics accelerator. Some computers have the graphics accelerator built in on the motherboard, and others use graphics accelerator cards. If you are buying a Windows-based PC and you plan to add a graphics accelerator, make sure your computer has an Accelerated Graphics Port (AGP) slot. Newer motherboards have an AGP slot as well as the normal PCI peripheral slots.
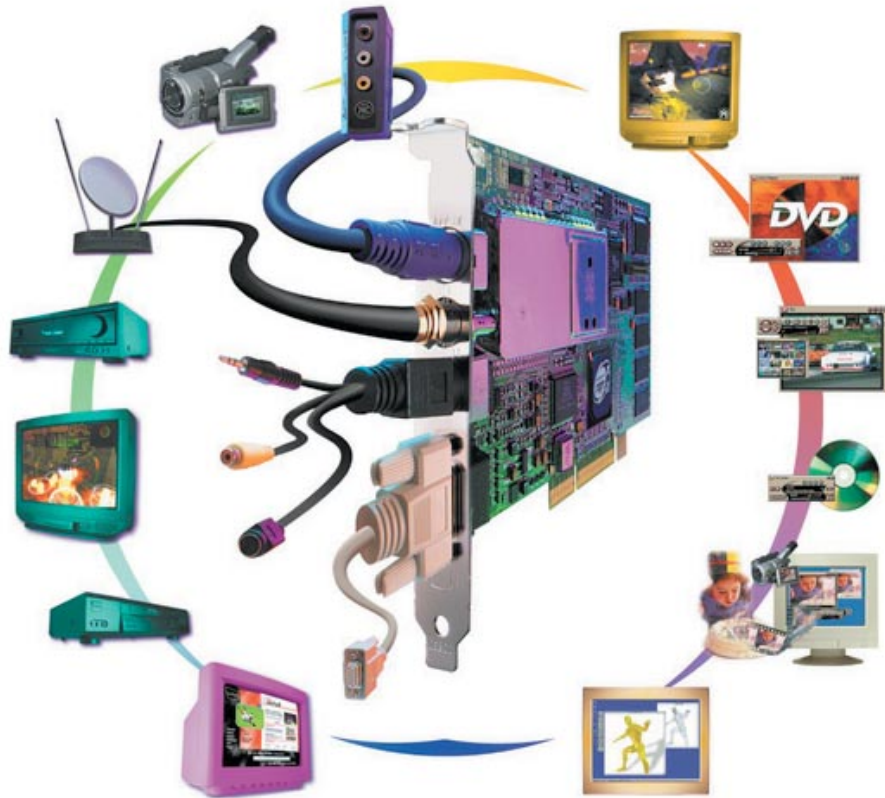
Video Overlay

Video overlay allows a computer to display common video sources including video cameras, VCRs, and videodiscs while simultaneously displaying computer graphics. The overlay circuitry makes one of the colors in the computer graphics transparent; when that color appears on the screen with the video overlay driver activated, the video source shows through.

Some computers come with video overlay built in. To add it to a computer that does not already have it, you need to purchase a video overlay card. You must exercise caution when purchasing such a card. There are a lot of competing brands, and they do not all provide the features you may need. You should consider the following two features when making a purchase.

- **TV Tuner**. Some cards have a TV tuner on board. If you know in advance that you want a TV tuner in your computer, get it on your video overlay card to save the slot you will need when you add the tuner later.

- **Full Motion Video Capture**. Overlay cards do not necessarily enable you to record full-motion video; if you want to make video recordings, you need an overlay card that can capture moving video.

Figure 11-5 shows how the All-In-Wonder board from ATI Technologies can do all these things. For more information, follow the *Multilit* Web site link to ATI All-In-Wonder. Also linked to the *Multilit* site is the Hauppage WinTV overlay board.

Figure 11-5   The All-In-Wonder card surrounded by an artist's depiction of the things it can do.

TV Tuner

TV tuner cards give a multimedia computer the ability to tune in to both broadcast and cable television channels. Some have video overlay capability on board, whereas others require that you have a video overlay card to which you can connect the video output of your tuner card. If you know in advance that you will want a TV tuner, purchase an overlay card that has a TV tuner built in.

MIDI

MIDI stands for Musical Instrument Digital Interface. Because MIDI is a required part of the multimedia PC specification, you do not have a multimedia computer if you do not have MIDI. Make sure that any new computer you buy has wavetable synthesis built in to its MIDI circuitry. Wavetable synthesis enables MIDI to play digitally sampled instrument sounds that are stored in the wavetable. This makes the instrumental sounds much more realistic than those produced by older multimedia PCs that did not have the wavetable.

MPEG

MPEG is emerging as the new digital video standard for the United States and most of the world. MPEG stands for *Motion Picture Experts Group,* the name of the ISO standards committee that created it. By definition, a multimedia computer must be able to play MPEG, or it is not a multimedia PC. Four versions of MPEG have been worked on:

- **MPEG-1** is the noninterlaced version designed for playback from CD-ROMs.

- **MPEG-2** is the interlaced version intended for the all-digital transmission of broadcast quality TV. Adopted by the United States Grand Alliance HDTV specification, the European Digital Video Broadcasting Group, and the Digital Versatile Disc (DVD-ROM) consortium, MPEG-2 does surround sound. RCA's DirecTV service uses MPEG-2.

- **MPEG-3** was to be the HDTV version of MPEG, but then it was discovered that the MPEG-2 syntax could fulfill that need by simply scaling the bit rate, obviating the third phase.

- **MPEG-4** is a low-bandwidth version of MPEG that is being invented for transmitting movies over mobile and wireless communications networks and over the Internet.

For more information, follow the links to MPEG at the *Multilit* Web site.

Multimedia Read/Write Storage

Multimedia requires a lot of storage if you are into digital audio and video. The storage alternatives are discussed here.

Hard Disk Drive

When you purchase a multimedia computer, you should get as much hard disk built into it as you can afford. No matter how much capacity you get, you will eventually run out as your library of multimedia software grows. Hard disk size is measured either in megabytes or gigabytes. A *megabyte* is a million bytes, and a *gigabyte* is a billion bytes. Anyone serious about multimedia should have at least 4 gigs of hard disk space.

Iomega Zip Disk and Jaz Disk

Iomega's Zip and Jaz disk drives are attractive storage mediums for multimedia developers because the disks are removable. The Zip disk drive comes in a USB version that makes it very easy to move from one computer to another. Zip disks come in two densities: 100 MB (which holds the equivalent of 70 diskettes) and 250 MB (equivalent to 175 diskettes). Iomega also manufactures a Jaz drive that is faster and holds a lot more data. Jaz disks come in 1GB (1,070 MB) and 2 GB (2,140 MB) formatted capacity. The Jaz drive is a SCSI device. For the latest information, follow the *Multilit* Web site link to Iomega.

Recordable CD-ROM

Recordable CD-ROM is called **CD-R**; the *R* stands for recordable, indicating that you can record on the CD. Each CD-R disc can store about 650 MB. CD-R drives have fallen in price and are a very cost-effective way of backing up your data. In quantities of 50 or more, blank CD-R discs cost less than a dollar each.

Recordable DVD

Recordable DVD is called **DVD-R**. The DVD-R recorders and discs cost more than CD-R, but they also hold more data. DVD-R is an emerging technology. The first DVD-R discs can hold up to 3.95 gigabytes (3.95 billion bytes) of information on each side. Since the DVD format supports two-sided media, a total of 7.9 GB can be stored on a two-sided DVD-R disc. That is 12 times as much data as fits on a CD-R disc. Eventually, perhaps by the time you read this, DVD-R will be able to hold even more. To find out, follow the *Multilit* Web site link to DVD-R.
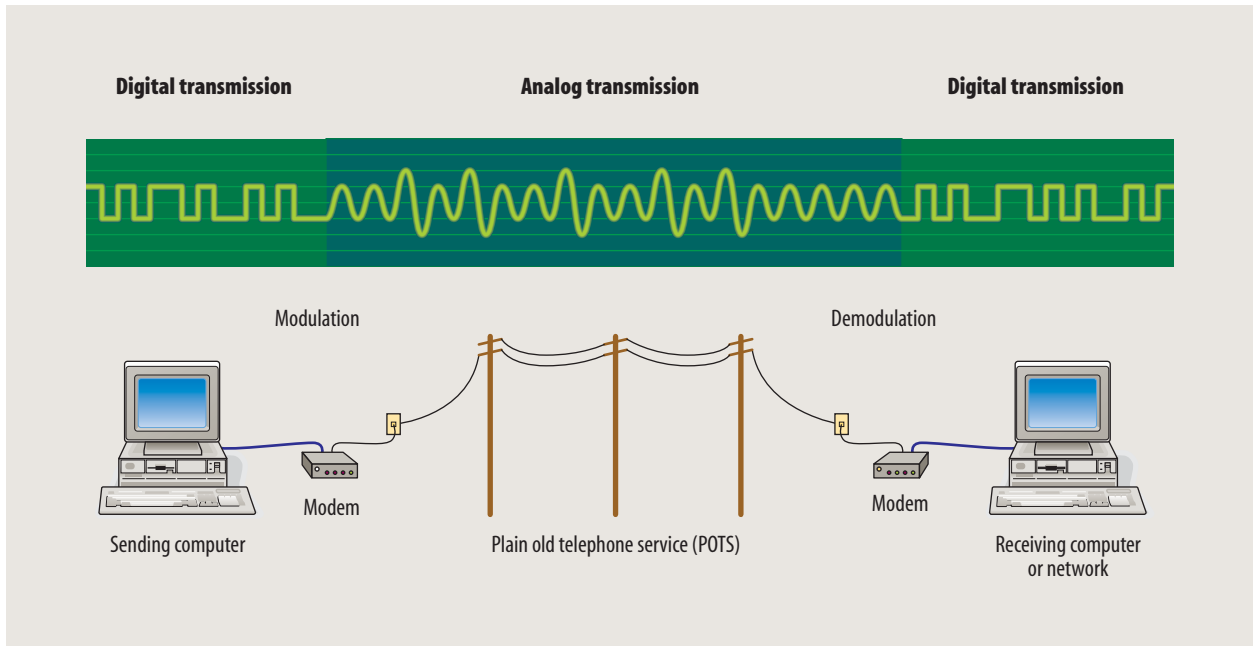
Communication Options

The datacommunication protocol used on the Internet is called **TCP/IP**, which stands for Transmission Control Protocol/Internet Protocol. Both the Windows and the Macintosh operating systems have support for TCP/IP built in. To connect your computer to the Internet via TCI/IP, you need either a modem or a network card. Most computers come with either a modem or a network card built in. When you purchase a new computer, you should think about whether you are going to connect it to the Internet via modem or network card, and make sure your new computer has what you need to get connected.

Telephone Modems

The most common means of connecting to the Internet from home is via plain old telephone service, also known as POTS. In order to communicate with the Internet over an ordinary telephone line, your computer must have a modem. Modems are so popular that most computers being sold today come with modems built in. Older models require the addition of external modems that connect to your computer's serial port, or modem cards that plug into one of your computer's expansion slots. Figure 11-6 illustrates how modems work by modulating and demodulating the computer's transmission; hence the term, *modem.*

Digital transmission   **Analog transmission**   **Digital transmission**

Modulation   Demodulation

Modem   Modem

Sending computer   Plain old telephone service (POTS)   Receiving computer or network

Figure 11-6   How modems work.

Modems have gotten steadily faster as computer technology has advanced. Modem speed is important because it determines how long you have to wait for information to arrive. Modem speed is often expressed in units known as bps, which stands for bits per second, or Kbps, which stands for a thousand bits per second. Common speeds are 14,400 bps (14.4 Kbps), 28,800 bps (28.8 Kbps), 33,600 bps (33.6 Kbps), and 56,000 bps (56 Kbps). Information traveling at 14,400 bps, for example, takes twice as long to arrive as it would at 28,800 bps.

ISDN

ISDN stands for Integrated Services Digital Network. It is the digital telephone system that is being installed by regional Bell companies in most of the United States. The basic rate service ranges in cost from $20 to $80 per month and offers a transmission speed of 144 Kbps, made up of two 64 Kbps data channels and one 16 Kbps control channel. In order to use ISDN to connect to the Internet, you will need to contact both your local telephone company and your Internet Service Provider, to find out whether ISDN is available in your area, and to make sure your ISP supports it.

DSL Modems

As datacommunications technology continues to advance, modems will continue to increase in speed. Someday, the so-called "high speeds" discussed in this book will seem slow. Digital subscriber line (DSL) modems, for example, can send data at speeds up to 2 million bits per second. If you are tempted to purchase such a modem, however, first make sure that your ISP can support it. To find out whether DSL is available in your

community, follow the *Multilit* Web site link to the DSL Resource Center, where there is an excellent tutorial comparing DSL to the other ways of connecting to the Internet.

Network Cards

Network cards provide faster ways to access the Internet. If your school or workplace has high-speed Internet cabling, you should consider getting a network card so you can connect to the Internet at high speed. The most popular kind of network card is called **Ethernet** (pronounced *ee-thur-net*). Many multimedia computers come with Ethernet built in. Ethernet networks transmit data at high speed, up to 10 megabits per second (Mbps—mega means a million, so 10 Mbps means 10 million bits per second). At Ethernet speeds, a file that takes 10 minutes to transmit over a 14.4 Kbps modem arrives in just one second. Actual downloading times may vary depending on the number of users sharing the Ethernet.

When Bob Metcalfe invented Ethernet in 1973 as part of his Harvard Ph.D. thesis, Ethernet required the use of coaxial cable, which is the kind of wire used in cable TV. Now there is a so-called 10BaseT Ethernet that can use ordinary twisted-pair telephone wiring. There is also a newer 10/100BaseT Ethernet that can move data at rates up to 100 megabits per second.

Cable Modems

Cable modems offer high-speed Internet access over TV cables. Average costs range from $40 to $60 per month. Cable modems can theoretically offer speeds from 3 to 30 Mbps, but in the real world, where you are competing with other users in your neighborhood for available bandwidth, actual speeds range from 400 to 1440 Kbps. That is still a lot faster than an analog telephone modem. Many neighborhoods, however, do not yet have two-way cable modem service. When this book went to press, only about 30% of the TV cables in the United States had been converted to the hybrid fiber/coax (HFC) lines needed to deliver two-way cable modem service. To find out whether cable modem service is available in your neighborhood, contact your local cable TV company.

Auxiliary Input

The auxiliary input devices described here provide convenient ways to digitize preexisting texts and pictures for use with a multimedia computer. The program that converts scanned text into machine-readable characters is known as optical character recognition (OCR) software. OCR software does not necessarily ship with scanners, so if you plan to scan printed text into machine-readable form, make sure you have the necessary OCR software. The best OCR software is industry leader Caere Corporation's OmniPage. For the latest information, follow the *Multilit* Web site link to Caere, where you will find a comprehensive guide to scanners.

Handheld Scanners

Handheld scanners have fallen in cost while increasing in reliability. The author used a handheld scanner extensively to scan the quotations that appear in this book. If you are an educator, be sure to ask the vendor if there is an educational discount; most scanner manufacturers have special discounts for educators. 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. Pictured in action in Figure 11-7, the

Figure 11-7   The IRISPen scans editable text into the current
cursor position.

IRISPen scans editable text into the current cursor position. For more information, follow the *Multilit* Web site links to handheld scanners.

Flatbed Scanners

Flatbed scanners do a nice job of scanning both text and graphics, and the price of color flatbed scanners has fallen steadily. If your budget permits, a flatbed scanner is a good addition for producing multimedia text and image objects. To find out more about flatbed scanners, follow the *Multilit* Web site link to industry leader Hewlett-Packard's family of ScanJet scanners.

Page-Fed Scanners

Page-fed scanners cost less and work as well as flatbed scanners, with the obvious constraint that you can feed only single pages into a page-fed scanner. On flatbed scanners, you can lay an open book down and scan the page without having to make a copy of it first to feed into a page-fed scanner. For this reason, a flatbed scanner is more versatile.

Slide Scanners

Slide scanners have a slot into which you insert a 35mm slide; their purpose is to scan the slide and produce a bitmap image of it. If you have a lot of 35mm slides to digitize, follow the *Multilit* Web site link to Polaroid, which sells a highly rated slide scanner. If you have only a few 35mm slides to digitize, however, it will be more cost-effective for you to send them to Kodak for digitizing onto a Photo CD. For more information, follow the *Multilit* Web site link to Kodak Photo CD.

Digital Cameras

As digital cameras fall in price and increase in resolution, they will eventually obviate the need for slides by making film unnecessary. High-end digital cameras already have color sharpness and resolution that rival the quality of a 35mm slide, which has an effective

resolution of about 4000 × 4000 pixels. When this book went to press, for example, Kodak already was marketing professional digital cameras with resolutions exceeding 3000 × 2000 pixels. If you only need to snap pictures for display on a Web page, however, you won't need such an expensive camera. To compare the features and prices of digital cameras, follow the *Multilit* Web site link to CNET or the Computer Shopper and search for Camera. When you buy a camera, make sure it is capable of snapping a picture with the color depth and pixel resolution you need.

Snappy

Snappy Video Snapshot is an image capture module that connects to the parallel port on the back of a desktop or laptop PC. Snappy can capture still images from any video source, such as a camcorder, at resolutions up to 1500 × 1125 pixels with 16 million colors. There is a Snappy demo on the *Multilit* CD. To run the demo, go to the Demonstrations section, select Software, and click the Snappy button. For information about the latest version, follow the *Multilit* Web site link to Snappy.

Videoconferencing Cameras and WebCams

Videoconferencing cameras, also known as WebCams, have dropped in price so rapidly that they are becoming a mass-market consumer item. To compare prices and features among the cameras that are available, follow the *Multilit* Web site link to CNET or the Computer Shopper and search for WebCam. Chapter 35, which is a step-by-step tutorial on digital video recording and editing, features the Logitech QuickCam family of WebCams. The QuickCam comes in a USB version that can connect to any Windows PC or Macintosh with a USB port. When you purchase a WebCam, make sure your computer has the kind of port needed for connecting the camera.

Computer Projectors

Computer projectors connect to the monitor output of a multimedia computer to project the computer display onto a large viewing surface for use in auditoriums, classrooms, and board rooms. There are four kinds of projectors: CRT (cathode ray tube), LCD (liquid crystal display), DLP (digital light processor), and PDP (plasma display panel). The best place to see all the different projectors in action is at the annual Infocomm conference, which has a projection shoot-out in which all the vendors line their projectors up around a huge auditorium where you can walk around and compare how well the different projectors display the same video signal. For more information, follow the *Multilit* Web site link to Infocomm and its parent organization, the International Communications Industry Association (ICIA), where you can follow the links to the Projection Encounter for a very highly produced multimedia tutorial on projection technology.

Printers

No list of computer accessories would be complete without mentioning printers. The quality of the printed output is largely determined by how many dots per inch (dpi) the printer can produce. Printers that print at 300 dpi produce acceptable graphics, but 600 dpi looks a lot better. This book was produced on a printer with 2400 dpi.

Because color is important in multimedia applications, you would ideally like to have a color printer. Happily, the cost of color printers has been declining steadily. If you do not have a color printer, however, your computer's printer driver will automatically convert color bitmaps to grayscale images that look surprisingly good when printed on a monochrome printer.

Laser printers produce the best and fastest prints, but they also cost the most. Inkjet printers are an alternative that costs less yet looks almost as good so long as you do not smear the ink before it dries. Some inks run when you get them wet, which is another reason why laser printers are preferred over inkjets.

For the latest information about printers, follow the *Multilit* Web site link to CNET or the Computer Shopper and search for printers.

e x e r c i s e s

1. Define the following terms and explain the role they play in a multimedia computer:

   - Central processor

   - RAM

   - Hard disk

   - Modem

2. Run through the multimedia components discussed in this chapter and make a list of which ones your computer has, which ones it does not have, and, of the latter, which ones you would like it to have.

3. Have you ever used a trackball? If not, go to your local video arcade and play a game that uses one. What advantages does the trackball have over a mouse? What are the disadvantages? Which do you prefer?

4. Have you ever used an optical mouse? If not, go to your local computer store and try out the Microsoft IntelliMouse Explorer. How does the optical mouse compare to the kind of mouse that has a rolling ball? Which kind of mouse would you rather use, an optical mouse, or a rolling ball mouse?

5. Go to www.kodak.com and search for digital cameras. When this book went to press, the highest-resolution camera being marketed by Kodak had a pixel grid of 3060×2036. What is the pixel grid of the highest-resolution camera Kodak is marketing now?