Estimated Time:
2 hours

LESSON 2

Input, Output, and Processing

OBJECTIVES

Upon completion of this domain, you should be able to:

- Identify and describe standard and specialized input devices.
- Identify and describe standard and specialized output devices.
- Connect input and output devices to a computer.
- Consider computer performance factors.

DATA FILES

You do not need data files to complete this lesson.

WORDS TO KNOW

audio input
biometrics
digital camera
expansion slot
FireWire
inkjet printer
input
keyboard
laser printer
modem
monitor
mouse
output
plug and play
pointing device
port
printer
scanner
trackball
Universal Serial Bus (USB)

VOCABULARY
input
modem
keyboard

When it comes to processing data, the computer does all of the work. However, it needs help. ***Input***, which is data or instructions, must be entered into the computer and then stored temporarily or permanently on a storage media device. To turn the data into information, it must be processed. The central processing unit (CPU), which you learned about in Lesson 1, processes the data. After the data is processed, it is presented to you through an output device.

IC3 1-1.1.5

Standard Input Devices

Input devices enable you to enter data and commands into the computer. Output devices enable the computer to give you the results of the processed data. Some devices, such as the fax machine and fax modem, perform both input and output functions. You use these devices to send (output) and receive (input) data over communications media. A ***modem*** is a device that allows one computer to talk to another.

The type of input device you use is determined by the task you need to perform. An input device can be as simple as a keyboard or as sophisticated as devices used for voice or retinal recognition.

Keyboards

The ***keyboard*** is the most commonly used input device for entering text and numbers into a computer. If you want to use the computer efficiently, you must learn to type. Most of the keyboards provided with desktop computers are enhanced. An enhanced keyboard has 12 function keys along the top, two Alt keys, two Ctrl keys, an Ins key and Delete key, and a set of directional/arrow keys between the typing area and the numeric keypad.

Some keyboards, such as the one shown in **Figure 2–1**, have multimedia hot keys for accessing e-mail and the Internet and adjusting speaker volume. Enhanced keyboards also might provide other features such as a zoom key or slider. This feature makes it easy to zoom in for a closer look at documents, spreadsheets, pictures, maps, and Web pages, for example.

Courtesy of Logitech

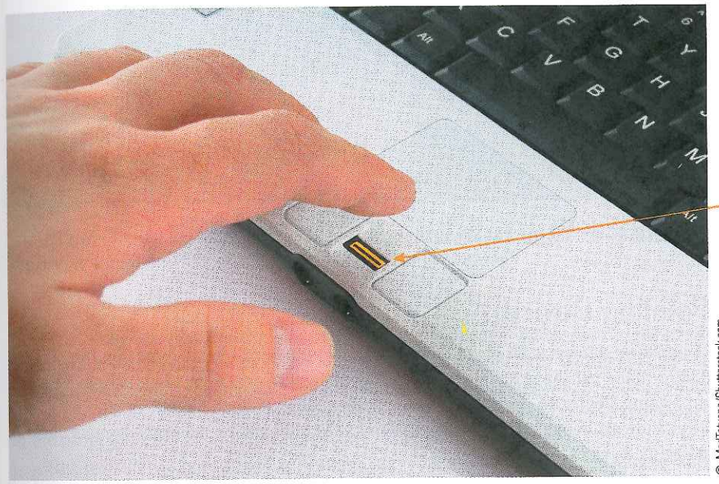
FIGURE 2–1 Enhanced keyboard

Not all keyboards, however, are traditional. Some other popular types of keyboards are:

- *Ergonomic*: This type of keyboard lets you use more natural and comfortable hand, wrist, and arm positions.
- *Cordless or wireless*: This is a battery-powered keyboard that transmits data using wireless technology.
- *Specialized*: This keyboard has specialized keys that represent items such as those used in fast-food restaurants.
- *Security*: This keyboard provides security features such as a biometric fingerprint reader, magnetic stripe, and smart card readers (see **Figure 2–2**).

ABOVE AND BEYOND

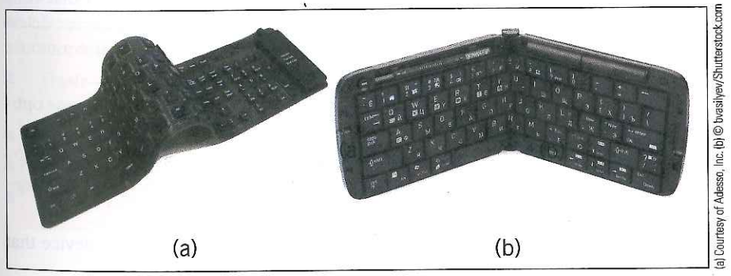
Need more space on your desk? Consider the Nearly Indestructible Keyboard (NIK)—it is flexible, can be rolled up and put into a briefcase, and even washed with soap and water or a spray cleaner *(www.dovecoteglobal.com/nik.html)*.



© MadTatyana/Shutterstock.com

FIGURE 2–2 Keyboard with fingerprint reader

- *Foldable or flexible*: An easily transported keyboard primarily used with mobile devices, this type of keyboard is soft to the touch and is water resistant (see **Figure 2–3**).



(a) Courtesy of Adesso, Inc. (b) © bvasilyev/Shutterstock.com

FIGURE 2–3 Foldable keyboards

- *Laser virtual keyboard*: Packaged in a case smaller than a soda can, a laser beam generates a full-size laser keyboard. This keyboard easily connects to any personal computer, including Macintosh, BlackBerry or other smart phone, and most other handheld devices (see **Figure 2–4**).

Courtesy of Celluon

FIGURE 2–4 Laser virtual keyboard

Pointing Devices

VOCABULARY
pointing device
mouse

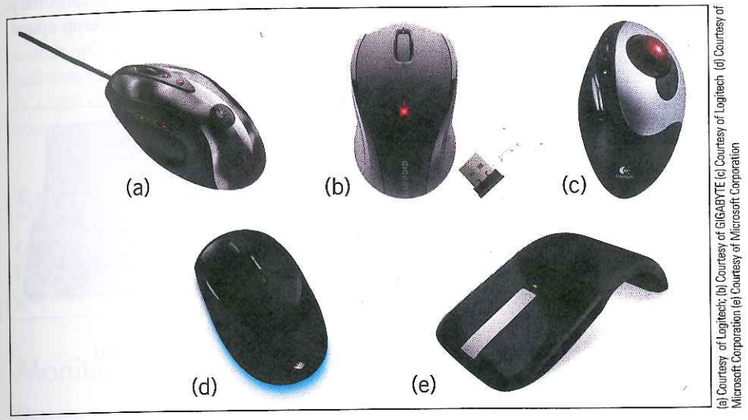
A ***pointing device*** is an input device you use to position the pointer on the screen. The pointer can have several shapes, but the most common is an arrow. You use a pointing device to move the pointer; select objects such as text or graphics; and click buttons, icons, menu items, and links. The following sections discuss various pointing devices.

Mouse

The most common pointing device for personal computers is the ***mouse***. It moves on a flat surface and controls the pointer on the screen. The mouse fits conveniently in the palm of your hand. You can use any of the following types of mice:

- *Mechanical*: This type of mouse has a ball located on the bottom that rolls around on a flat surface as you move the mouse. Sensors inside the mouse determine the direction and distance of the movement. In general, you use a mouse pad with a mechanical mouse.
- *Optomechanical*: This mouse is the same as a mechanical mouse, but uses optical sensors to detect the motion of the ball.
- *Optical*: An optical mouse (see **Figure 2–5a**) uses a laser to detect the mouse's movement. Optical mice have no mechanical moving parts. They respond more quickly and precisely than mechanical and optomechanical mice.
- *Wireless*: A wireless mouse (see **Figure 2–5b**) is a battery-powered device that relies on infrared waves to communicate with the computer.
- *Trackball mouse*: This is an upside-down mechanical mouse, with the ball on the top (see **Figure 2–5c**).

- *Radio frequency*: This type of mouse is similar to a typical wireless mouse, but uses radio frequency instead of infrared waves (see **Figure 2–5d**).
- *Foldable mouse*: This is a wireless foldable mouse (see **Figure 2–5e**).



(a) Courtesy of Logitech; (b) Courtesy of GIGABYTE (c) Courtesy of Logitech (d) Courtesy of Microsoft Corporation (e) Courtesy of Microsoft Corporation

FIGURE 2–5 (a) Optical mouse (b) Wireless mouse (c) Trackball mouse (d) Radio frequency cordless mouse (e) Foldable mouse

Most mice have two or three buttons; many also have a wheel. You use the left button for most mouse operations. Generally, clicking the right button displays a shortcut menu. After you place the on-screen pointer where you want it, press a button on the mouse. This triggers an action in the computer; the type of action depends on the program. Use the wheel to scroll or to zoom a page or image.

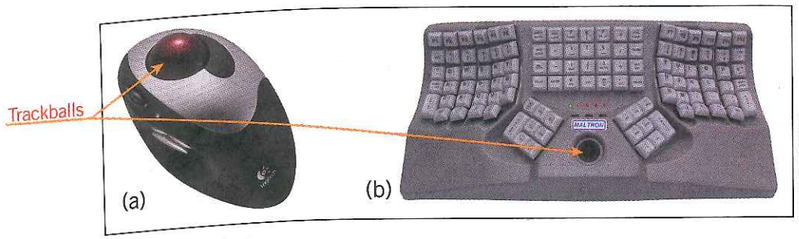
You use the mouse in the following ways in many software programs and Web pages:

- *Pointing*: Placing the on-screen pointer at a designated location
- *Clicking*: Pressing and releasing the mouse button to select a specific location within a document
- *Dragging*: Pressing down the mouse button and moving the mouse while continuing to hold down the button to highlight a selected portion of text
- *Double-clicking*: Pressing and releasing the mouse button two times in rapid succession to select a word
- *Triple-clicking*: Pressing and releasing the mouse button three times in rapid succession to select a paragraph
- *Right-clicking*: Pressing the right mouse button to display a menu
- *Rotating*: Rotate the wheel forward or backward to scroll vertically
- *Tilting*: Pressing the wheel right or left to scroll horizontally

VOCABULARY
trackball

Trackball

The ***trackball*** is a pointing device that works like a mouse turned upside down; the ball is on top of the device. See **Figure 2–6a**. You use your thumb and fingers to operate the ball, which controls the pointer on the screen. A trackball is stationary, making it a good alternative to the mouse when you have limited desktop space. Some trackballs are built into the keyboard (see **Figure 2–6b**).



(a) Courtesy of Logitech
(b) Courtesy of PCD Maltron

FIGURE 2–6 (a) Trackball on a mouse (b) Trackball on a keyboard

ABOVE AND BEYOND

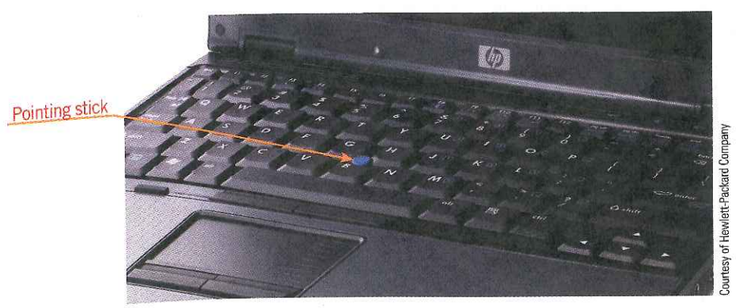
A typical wired mouse has a power consumption rating of about 0.5 watts (5 V/100 mA). One hundred milliamperes (mA) is the maximum additional current that a mouse can draw, according to the USB 2.0 specification. In comparison, a wireless mouse uses only a small receiver for power, which draws a maximum of 0.075W.

Touchpad

A common feature on laptop computers is the touchpad, a pointing device with a specialized surface that can convert the motion and position of your fingers to a relative position on screen. Portable media players also include touchpads.

Pointing Stick

Some notebook computers contain a pointing stick, a pressure-sensitive device that looks like a pencil eraser. It is located on the keyboard, generally between the G, H, and B keys. See **Figure 2–7**. You move a pointing stick with the forefinger, while using the thumb to press related keys. In a confined space, many people find a pointing stick more convenient than a mouse. IBM popularized this device by introducing the TrackPoint on its ThinkPad notebooks.



Courtesy of Hewlett-Packard Company

FIGURE 2–7 Pointing stick

Audio Input

Audio input is sound entered into a computer. Sound includes speech, sound effects, and music. Examples of audio input devices are microphones, CD/DVD players, radios, and other hardware such as electronic keyboards. Voice input is a category of audio input. You can use voice-recognition devices such as microphones to speak commands into the computer and to enter text. The computer must have voice-recognition software installed before you can use a voice-recognition device. Directory assistance is a type of voice-recognition technology, as are devices that disabled persons use to command wheelchairs and other objects to increase mobility.

VOCABULARY
audio input
output
monitor

Standard Output Devices

IC3 1-1.1.5

Output is data processed into a useful format. Output devices display information. Examples of output are printed text, spoken words, music, pictures, video, and graphics. The most common output devices are monitors and printers.

Monitors

Desktop computers typically use a ***monitor*** as their display device. The screen is part of the monitor, which also includes the housing for its electrical components. Screen output is called soft copy because it is temporary.

The cathode ray tube (CRT) was one of the earliest types of computer monitors. See **Figure 2–8a**. CRT monitors are similar to older models of televisions and can display monochrome or color output. A monochrome monitor has a one-color display, which can be white, green, or amber. Color monitors display thousands of colors. Common sizes for CRT monitors are 17-, 19-, and 21-inch, though some are 30 inches or more. CRT monitors are nearly obsolete and have largely been replaced by flat-panel monitors.

Flat-panel monitors come in two varieties: liquid crystal display (LCD) and gas plasma. They take up less space than CRT monitors and are much lighter in weight, though they provide a larger viewing area.

LCD panels produce an image by manipulating light within a layer of liquid crystal cells. See **Figure 2–8b**. LCD panels were originally used on notebook computers and other mobile devices such as cell phones and PDAs. In 1997, several manufacturers started producing full-size LCD panels as alternatives to CRT monitors. LCD panels are now the primary technology for computer monitors, and are usually produced in widescreen sizes, which allow two pages to be displayed side by side in word-processing software. Older LCD monitors do not have a widescreen format, but produce a nearly square screen display.

Gas plasma technology consists of a tiny amount of gas that is activated by an electrical charge. See **Figure 2–8c**. The gas illuminates miniature colored fluorescent lights arranged in a panel-like screen. These monitors have a brilliant color display and are available in sizes up to 60 inches or more. Similar to LCD monitors, gas plasma displays are typically produced in widescreen sizes.

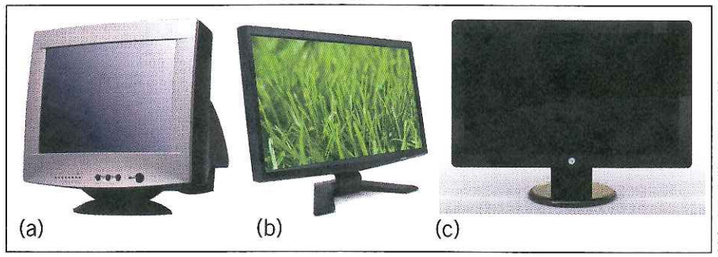


FIGURE 2–8 (a) CRT monitor (b) LCD panel (c) Gas plasma display

Printers

VOCABULARY
printer

Printers produce a paper copy, or hard copy, of processing results. Printer output is called hard copy because it is permanent. Several types of printers are available, with significant differences in speed, print quality, price, and special features.

When selecting a printer, consider the following features:

- *Speed*: Printer speed is measured in pages per minute (ppm). The number of pages a printer can print per minute varies for text and for graphics. Graphics print more slowly than regular text.
- *Print quality*: Print quality is measured in dots per inch (dpi). The higher the dpi, the better the resolution or print quality.
- *Price*: The price includes the original cost of the printer and what it costs to maintain the printer. You can purchase a good-quality printer very inexpensively whereas a high-output system can cost thousands of dollars. The ink cartridges and toners need to be replaced periodically.

Printers are classified as either impact or nonimpact. Impact printers use a mechanism that actually strikes the paper to form letters and images. Dot matrix printers are impact printers, though they are mostly obsolete. Nonimpact printers form characters without striking the paper. The two most popular types of printers, laser printers and inkjet printers, are examples of nonimpact printers.

Laser Printers

VOCABULARY
laser printer

A ***laser printer*** produces images using the same technology as copier machines. The image is made with a powdery substance called toner. A laser printer produces high-quality output. Laser printers are generally affordable for most consumers. Color laser printers, however, are still expensive, some costing thousands of dollars. **Figure 2–9** illustrates how a laser printer works.

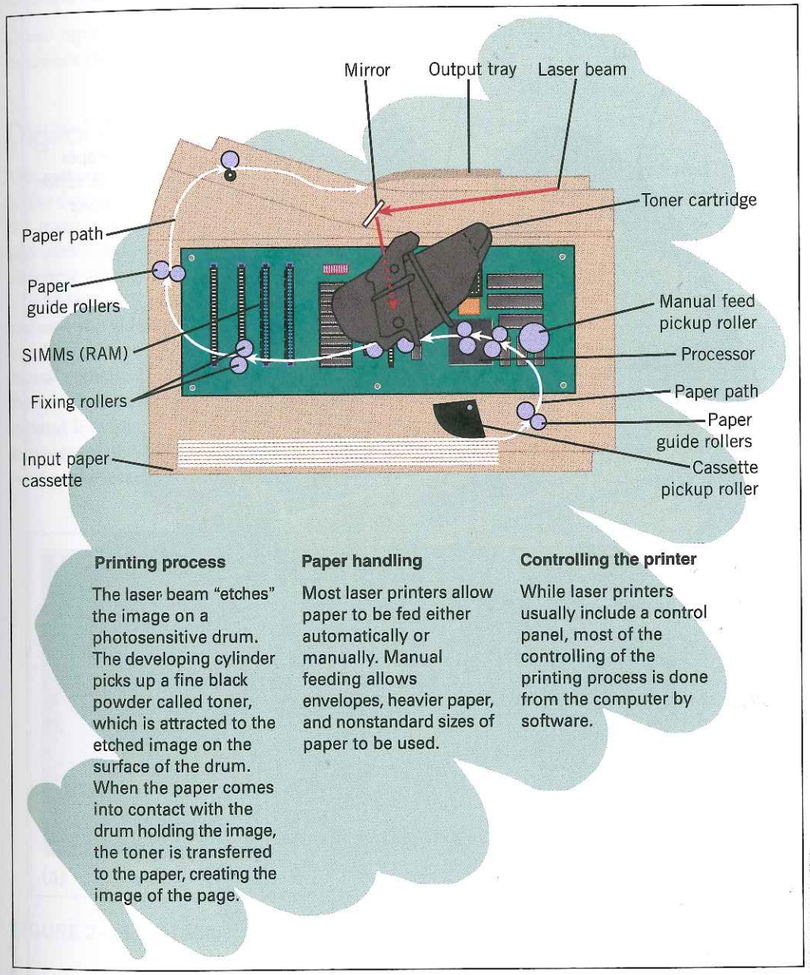


FIGURE 2–9 How a laser printer works

Inkjet Printers

VOCABULARY
inkjet printer

An ***inkjet printer*** provides good-quality color printing for less expense than a laser printer. **Figure 2–10** shows how an inkjet printer works. Inkjet printing, like laser printing, is a nonimpact process. Nozzles squirt ink as they pass over the media. Unlike earlier versions of the inkjet printer, newer versions can use regular photocopy paper.

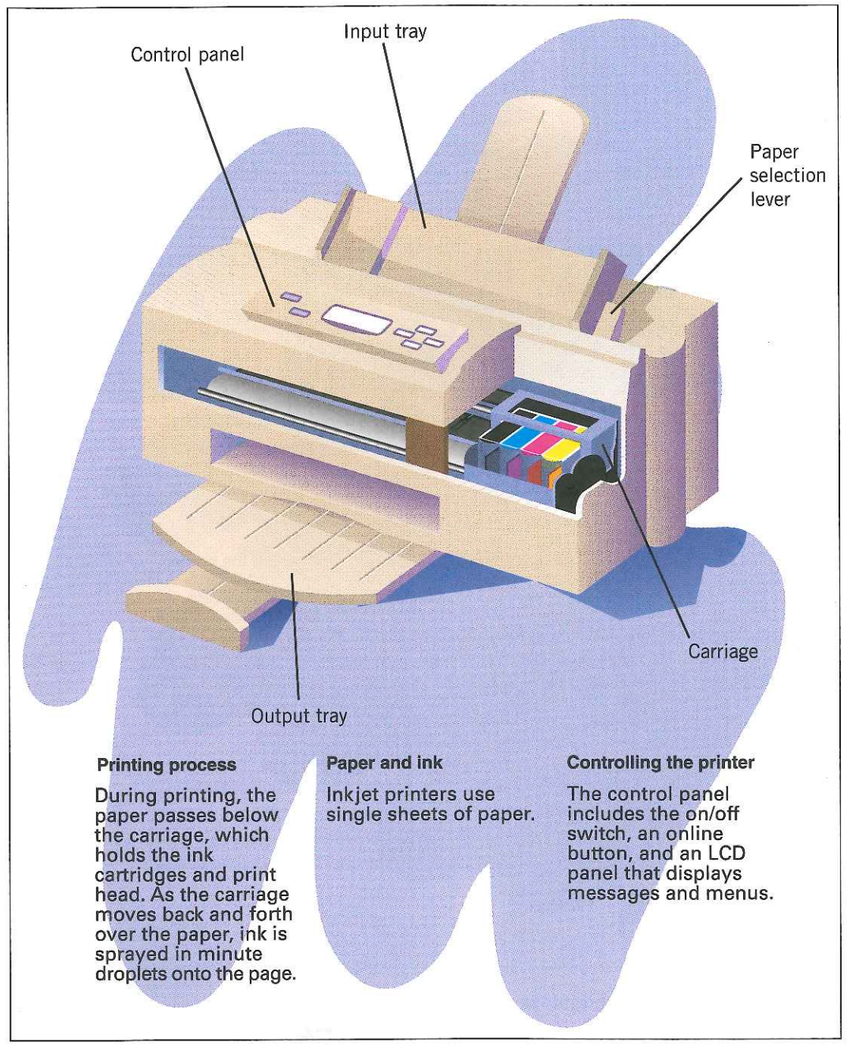


FIGURE 2–10 How an inkjet printer works

Speakers

Speakers also are a type of output device. Speakers and headsets generate sound, such as music or instructions on how to complete a tutorial. You use headsets or earphones to hear the music or other voice output privately.

Specialized Input Devices

IC3 1-1.1.6

Other input devices are used for specialized applications. The following section describes these input devices.

Digital Cameras

VOCABULARY
digital camera

The pictures you take with a ***digital camera*** are stored digitally and then transferred to the computer's memory. Digital cameras use a variety of storage media to store the images, including flash memory cards, memory sticks, USB keys, mini-discs, and other solid-state storage devices. After transferring pictures to the computer, you can view them quickly and edit any imperfections with photo-editing software.

Video input is a set of full-motion images captured with a video camera. You can save the video on a storage medium such as a hard drive, CD, or DVD. After saving the video, you can view and edit it. A digital video (DV) camera records video as digital signals; some DV cameras also capture still images. Some are a little larger than a credit card. A PC video camera is a type of digital video camera you can use to send live images over the Internet, make video telephone calls, and send e-mail messages with video attachments. The mini digital camera is small enough to fit in your pocket (see **Figure 2–11a**).

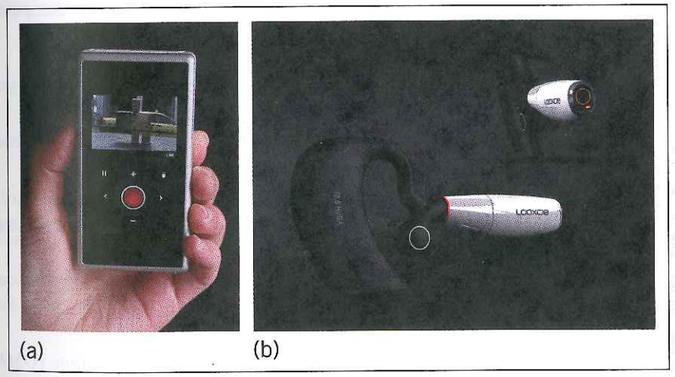
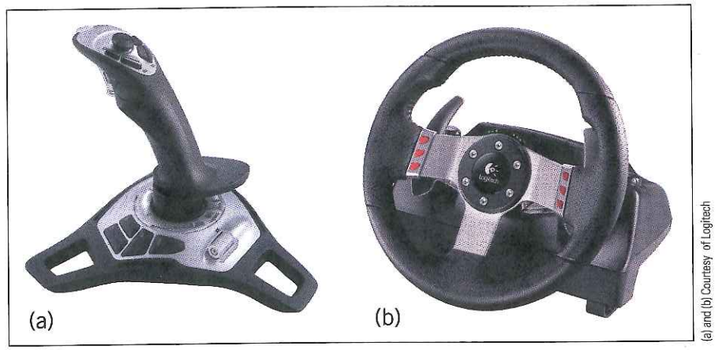


FIGURE 2–11 (a) Miniaturized digital video camera (b) Wearable video camera

Webcams are video-capturing cameras connected to computers or to computer networks; they display images through the World Wide Web. Generally, you use Webcams for videoconferencing and communications. You can also use Webcams for security purposes, monitoring both movement and sound. The Looxcie Webcam shown in **Figure 2–11b** is a wearable video camera that stores up to five hours of video. You can use this Webcam to instantly capture and share clips on social networks, and rewind to save the past 30 seconds of action.

Game Controllers

The joystick and wheel are types of pointing devices. You use joysticks and wheels, such as the ones shown in **Figure 2–12**, most often for games. The joystick consists of a plastic or metal rod mounted on a base. You can move the rod in any direction. Some joysticks have switches or buttons that can input data in an on/off response. A wheel is a device you use to simulate driving a vehicle. Most wheels also include foot pedals used for braking and acceleration actions.



(a) and (b) Courtesy of Logitech

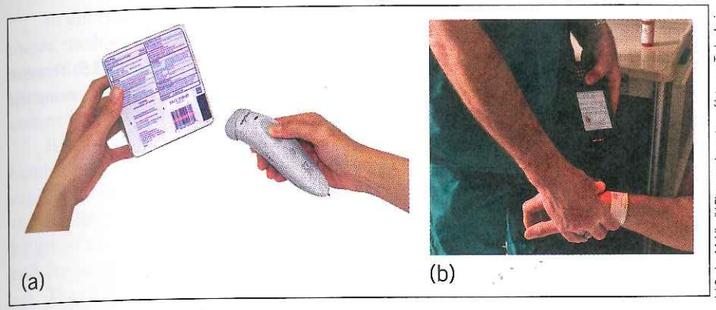
FIGURE 2–12 (a) Joystick (b) Wheel

Scanners/Bar Code Readers

VOCABULARY
scanner

Scanners are devices that can change images into codes for input to the computer. Scanners are available in various sizes and types, including the following:

- *Image scanners*: These devices convert images into an electronic form that you can store in a computer's memory. You can then manipulate the images.
- *Bar code scanners*: This type of scanner reads bar lines that are printed on products (for example, in a retail store). See **Figure 2–13a**.
- *Magnetic scanners*: These devices read encoded information on credit cards. The magnetic strip on the back of each card contains the user's encoded account number.
- *Wireless scanners*: These scanners use Bluetooth wireless technology to scan barcode data, such as from a hospital bracelet, and transmit it to a computer. See **Figure 2–13b**.
- *Optical character recognition (OCR) and optical mark recognition (OMR) scanners*: These devices use a light source to read characters, marks, and codes; the data is then converted into a digital format. Banks use OCR technology to scan checks. Commonly known as Scantrons, schools and other organizations use OMR for testing purposes.



(a) Socket Mobile (b) Photograph courtesy of Intermec Technologies

FIGURE 2–13 (a) Optical scanner (b) Bluetooth scanner

Touch Display Screen

The touch display screen, shown in **Figure 2–14**, is a special screen that reacts to direct touches within the display area, usually from a person's finger or hand. You use your fingers to "point" to the desired object to make a selection. You can find these screens in public places such as airports, hotels, banks, libraries, delivery services, and fast-food restaurants. Many mobile devices such as the popular iPhone and iPad products, notebook computers, and desktop computers have touch screens.

© Robnrol/Shutterstock.com

FIGURE 2–14 Touch screen

Stylus

A stylus and digital pen are pen-like writing instruments. See **Figure 2–15**. You use these devices to enter information by writing on a screen on a mobile device or using the pen as a pointer.

© NatUlrich/Shutterstock.com

FIGURE 2–15 Mobile device with stylus

Environmental Probes and Sensors

Environmental monitoring in many industries and companies is a critical component of stabilization in the work area. With a standard Web browser such as Internet Explorer, workers can use environmental probes and sensors to view information such as the temperature and humidity of a remote environment, smoke detector readings, pollution control readings, and so on. A variety of industries, such as farming, tropical fish production, moisture monitoring, and warehouse security, use environmental probes and sensors.

Remote Controls

You use remote controls, also a type of specialized input device, to manage devices such as televisions, lights, and fans. Industry and business also use remote controls for various applications. For example, a construction worker can use a remote control to operate a crane, or a warehouse worker can have a remote control for a product cart.

Security Devices

Consider the following scenario: You are going on a two-week vacation to Ireland and England—you are packed and ready to go, but you do not need a wallet or credit cards. You use your fingerprint as an input device to pay for all of your expenses.

VOCABULARY
biometrics

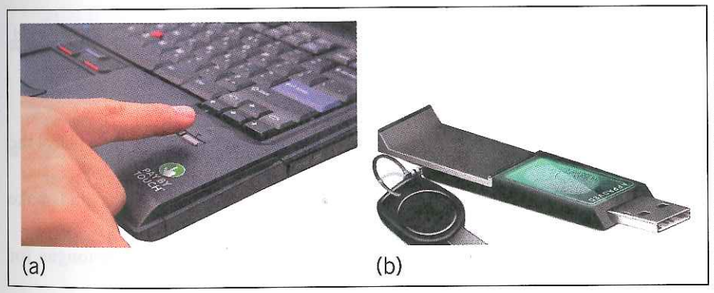
In information technology, ***biometrics*** is an authentication technique using automated methods of recognizing a person based on a physiological or behavioral characteristic. Biometric devices consist of a reader or scanning device and software that convert the scanned information into a digital format. Additional software then compares the scanned information to a database of stored biometric data.

Biometric technology can identify people based on their fingerprints, face, handwriting, or voice. Other less common techniques use the retina (analysis of the capillary vessels located at the back of the eye), iris (analysis of the colored ring surrounding the eye's pupil), hand geometry (analysis of the shape of the hand and length of the fingers), or vein (analysis of the pattern of veins on the back of the hand and the wrist).

The way biometric technology works, however, is basically the same for all identification techniques:

- *Enrollment*: You enroll in the system by establishing a baseline measurement for comparison.
- *Submission*: You present biological proof of your identity to the capture system.
- *Verification*: The system compares the sample you submitted with the stored sample.

Privacy and civil liberties advocates, however, are concerned about the widespread adoption of biometric systems. They argue that by using biometric data, unauthorized parties can access someone's data without their consent and link it to other information, resulting in secondary uses of the information. This erodes the users' personal control over their private information. On the other hand, biometrics can also be applied to private security. For example, several companies now offer biometric computer keyboards and USB flash drives with fingerprint authentication that can be used for personal applications. (Flash drives were discussed in Lesson 1.) See **Figure 2–16**.

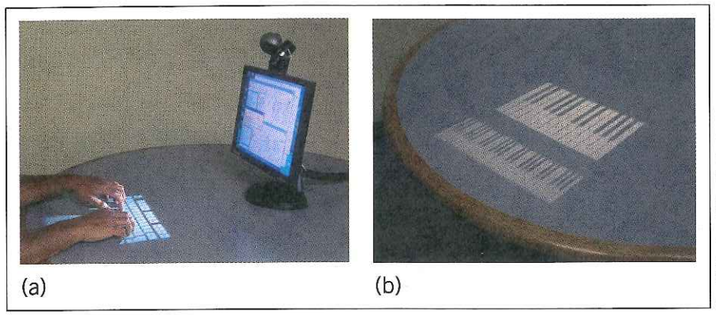


(a) PRNewsFoto/Pay By Touch (b) Courtesy of EnnovaDirect, Inc.

FIGURE 2–16 (a) Biometric keyboard scanner (b) USB fingerprint scanner

Virtual Devices

Similar to the laser virtual keyboard mentioned earlier, virtual devices use the synchronized positioning of light-emitting and sensing devices to detect user input. **Figure 2–17a** shows a virtual computer keyboard and **Figure 2–17b** shows a virtual piano keyboard.



(a) and (b) Courtesy of Virtual Devices, Inc.

FIGURE 2–17 (a) Virtual computer keyboard (b) Virtual piano keyboard

Touch-Sensitive Pads

The touch-sensitive pad on a portable device, such as an iPod, enables you to scroll through a list, adjust the volume, play music, view videos or pictures, and customize settings.

Input Devices for the Physically Challenged

A variety of special input devices are available for the physically challenged. Following are some examples:

- Some keyboards can be operated with one hand or with the feet.
- A program called Camera Mouse enables users to use a Webcam and control the mouse pointer by moving their heads.
- A human-computer interface uses eye control to move a pointer and make selections.
- A joystick computer mouse can be operated with the lips, chin, or tongue for people with little or no head movement.
- Voice input devices allow visually impaired, blind, and physically challenged people to more easily interact with computers.
- A computer display screen is sensitive to human touch and allows the user to interact with the computer by touching an active area or a target, or to control data such as pictures or words on the screen.

Specialized Output Devices

IC3 1-1.1.7

Similar to specialized input devices, a variety of specialized output devices are also available:

- *Projectors*: A data projector projects the computer image onto a screen, usually for presentations.
- *Fax machines and fax modems*: These devices transmit and receive documents over a telephone line or through a computer.
- *Multifunction printer*: A multifunction printer combines output options such as printing, scanning, copying, and faxing.
- *Control devices/robots*: The field of robotics is defined as the study, design, and use of robot systems for manufacturing. Typical applications of robots include testing, product inspection, assembly, packaging, and painting.

Specialized Printers

Impact printers, such as the dot matrix and line printer, have been around for a long time. Dot matrix printers transfer ink to the paper by striking a ribbon with pins. The higher the number of pins, the better the resolution or output. The mechanism that actually does the printing is called a printhead. The speed of the dot matrix printer is measured in characters per second (cps). With the reduction in cost of laser and ink jet printers, dot matrix printers are seldom used today. A variation of the dot matrix printer is the line printer. This type of high-speed printer is attached primarily to large computers such as mainframes or midrange servers.

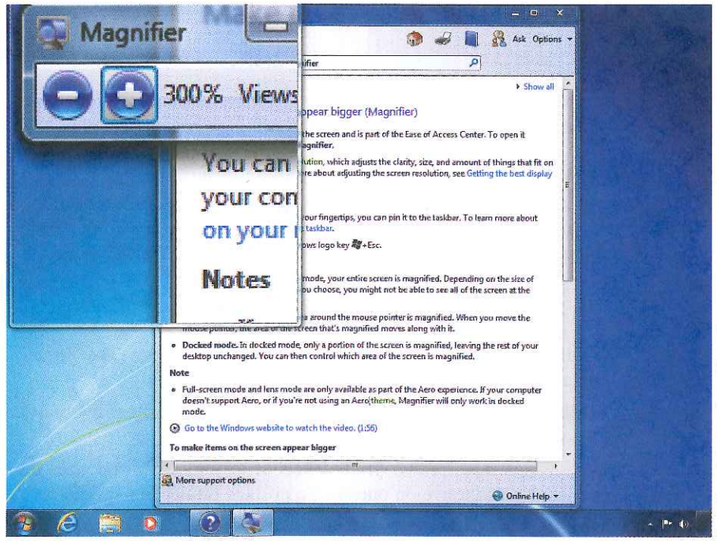
Several other types of specialty printers are available. Some examples are:

- *Thermal*: A thermal printer forms characters by heating paper. The printer requires special heat-sensitive paper.
- *Mobile*: A mobile printer is a small, battery-powered printer, primarily used to print from a notebook computer.
- *Label and postage*: A label printer prints labels of various types and sizes on paper that contains an adhesive on one side; a postage printer is a special type of label printer. This type of printer contains a built-in digital scale and prints postage stamps.
- *Plotters/large-format*: Engineers, architects, and graphic artists use plotters and large-format printers for drawings and drafting output.

Output Devices for the Physically Challenged

Similar to input devices for the physically challenged, output devices are also available. Following are some examples:

- *Screen magnifiers*: These devices contain a range of magnifications and fonts that enlarge the information displayed on the computer screen (see **Figure 2–18**).
- *Screen readers*: A screen reader assists people who are visually impaired. A speech synthesizer generally reads the screen content. Some screen readers can also read scanned documents.
- *Voice synthesizers*: Speech synthesis is the computer-generated simulation of human speech. A voice changes written computer text into synthetic speech. This technology is useful especially for people with limited sight.



Used with permission from Microsoft Corporation

FIGURE 2–18 Screen magnifier

IC3 1-1.1.8

Connecting Input and Output Devices to a Computer

Input and output devices must be connected to the computer. Some devices connect to the computer through a physical connection, such as a port. You can plug the cable for a printer into a port located on the back, front, or side of the computer. Some monitors also have ports. Wireless devices connect through infrared or radio waves.

Ports and Connectors

A *port*, also called a jack, is an interface to which a peripheral device attaches to or communicates with the system unit or other peripheral devices. Older peripheral devices use serial and parallel ports to connect to the computer. Serial devices transmit data one bit at a time. Parallel devices transfer eight bits at a time. (Recall that a bit is represented by a 0 or 1. Typically, eight bits make one byte.) Older computers traditionally have at least one parallel port and one serial port, with a printer connected to the parallel port and a mouse connected to the serial port.

A ***Universal Serial Bus (USB)*** port can connect up to 127 peripheral devices with a single connector and transfer data at rates of up to 200 million bits per second (Mbps). (A bus transfers data between components inside a computer or between computers.) USB replaces the standard serial and parallel ports on today's computers. USB 3.0 is a recent and more advanced version of USB technology, with speeds 40 times faster than that of its predecessors. Personal computers typically have four to eight USB ports on the back, front, or side of the system unit. Using a daisy-chain arrangement or a USB hub, you can use a single USB port to connect up to 127 peripheral devices. A USB hub is a device that plugs into a USB port and contains multiple USB ports into which cables from USB devices can be plugged. USB also supports plug and play and hot plugging. ***Plug and play*** refers to the ability of a computer system to configure expansion boards and other devices automatically. Hot plugging means you can add and remove devices while the computer is running and have the operating system automatically recognize the change.

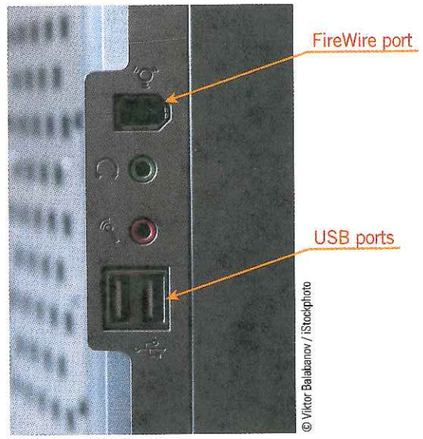
Another type of external bus is ***FireWire***, also known as IEEE 1394 and IEEE 1394b. The IEEE 1394 bus standard supports data transfer rates of up to 400 Mbps and can connect up to 63 external devices; IEEE 1394b provides speeds up to 3200 Mbps. **Figure 2–19** shows examples of FireWire and USB ports.

VOCABULARY

port
Universal Serial Bus (USB)
plug and play
FireWire

ABOVE AND BEYOND

The SuperSpeed USB (USB 3.0) is the most recent version of the USB specification, with ten times the current bandwidth of USB 2.0. Transfer rates are approximately 4.8 Gbits/sec (Gigabits per second) and have been available in commercial products since 2009.



© Viktor Balabanov / iStockphoto

FIGURE 2–19 USB and FireWire ports

In addition to the preceding ports, you might find three additional special-purpose ports on computing devices. These special-purpose ports are:

- *SCSI*: An abbreviation for Small Computer System Interface, SCSI (pronounced skuzzy) is a standard interface for connecting peripherals such as disk drives and printers.

- *IrDA*: A wireless standard that allows data to be transferred between devices using infrared light instead of cables is called IrDA. Both the computer and the device must have an IrDA port, and the IrDA port on the device must align with the IrDA port on the computer.
- *Bluetooth*: Bluetooth uses radio waves and provides wireless short-range communications of data and voice between both mobile and stationary devices. This technology does not require alignment; it is an alternative to IrDA. See **Figure 2–20**.

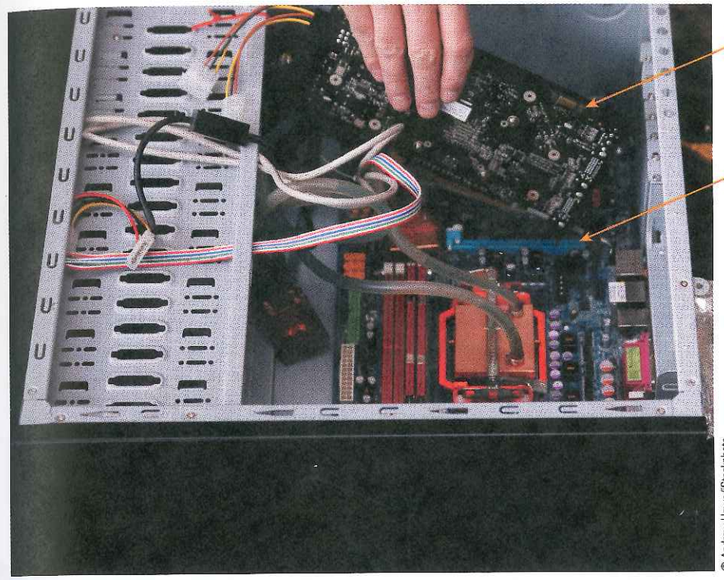
PC: Courtesy of Hewlett-Packard Company; **iPhone:** © kai zhang / iStockphoto; **Wireless mouse:** © Mau Horng/Shutterstock.com; **Wireless keyboard:** © Chiyacat/Shutterstock.com; **Bluetooth headset:** © Dja65/Shutterstock.com; **Inkjet printer:** © Lusoimages/Shutterstock.com; **Mobile phone:** © Patchnyushchka/Shutterstock.com; **Wireless gamepad:** © CAN BALDIOGLU/Shutterstock.com; **Wireless headphones:** © DUSAN ZIDAR/Shutterstock.com

FIGURE 2–20 Bluetooth devices

Traditionally, ports were located on the back of the system unit only. With the introduction of portable devices, such as digital cameras and smart phones, computers now also include ports on the front of the system unit. This location provides for easier access.

VOCABULARY
expansion slot

Expansion slots are openings on the motherboard where an expansion board can be inserted. Expansion boards enhance functions of a component of the system unit or provide connections through a port or other connectors to peripheral devices. Expansion boards are also called adapter cards, expansion cards, add-ins, and add-ons. See **Figure 2–21**.



© Andrew Howe/Stockphoto

FIGURE 2–21 Expansion slot and card

Hardware Installation

For most hardware devices to work, they need a set of instructions that communicates with the computer's operating system. This set of instructions is called a driver. The operating system usually includes drivers for popular peripheral devices and performs an automatic plug-and-play installation for newly connected devices.

If the operating system does not contain a driver for the hardware, you must install the driver manually. Usually, the software is included with the hardware device. If an installation disk is not available, the manufacturer's Web site generally provides a downloadable file.

Considering Computer Performance Factors

IC3 1-1.1.9

A variety of factors can affect a computer's performance. In Lesson 1, you learned about the central processor, computer memory, and input/output devices. These three components, plus video capability and disk organization, affect the speed at which the computer performs.

The following list provides an overview of the devices that affect computer performance.

1. *Microprocessor*: The architecture of the central processor is the most important processing element. CPUs are classified by generations. The higher the generation, the faster and better the processing speed. Most processors support parallel processing. With this type of processing, while one instruction is being executed, the next instruction is fetched from memory and decoded. Thus, the faster the processor, the more instructions per second it can process.

2. *Random access memory (RAM)*: The amount of RAM also helps to speed up the processing cycle and to enhance the computer's performance. When the memory capacity is reached, the CPU stores data on the hard drive. This slows down the processing cycle because it takes longer for the CPU to read from a hard drive than from RAM. To improve computer performance dramatically, increase the amount of RAM on your computer.

3. *Hard disk*: The size and speed of the hard drive also affects a computer's performance. The bigger and faster the hard drive, the faster it can process data. In addition, how the disk is organized is a performance factor. If a hard disk contains many unneeded and outdated files, it takes longer for the computer to find the information it needs.

4. *Video*: The video device connected to the computer can enhance or slow down the computer's performance. Having adequate video memory for the video card allows the processor to perform to its full potential.

Windows 7 provides several options to determine what hardware you have in your computer system. In Step-by-Step 2.1, you learn how to view this information. You might notice abbreviations such as MB or GB, which are units for measuring bytes, and were introduced in Lesson 1.

Step-by-Step 2.1

1. Click the **Start** button on the taskbar, and then click **Computer**. The Computer window opens, as shown in **Figure 2–22**.

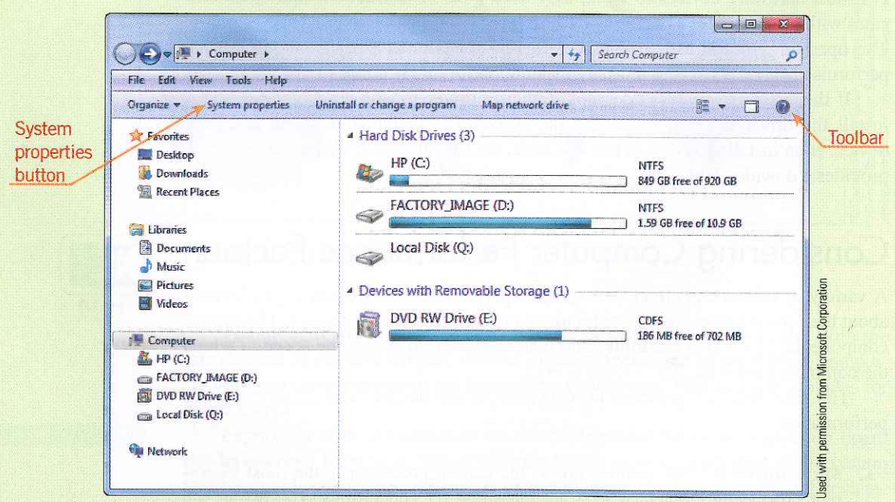


FIGURE 2–22
Computer window

Used with permission from Microsoft Corporation

2. Click the **System properties** button on the toolbar. The System window opens (see **Figure 2–23**). Most likely, your System window will display different system information.

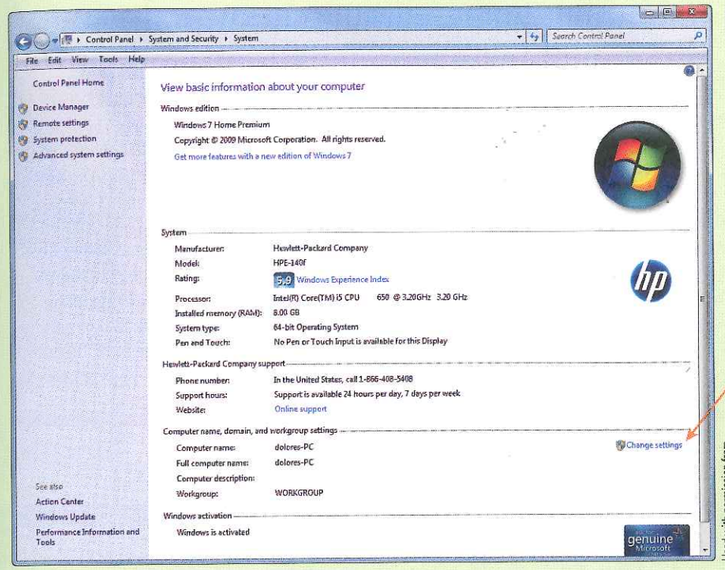


FIGURE 2–23
System window

Change settings link

Used with permission from Microsoft Corporation

3. What processor does your computer contain? How much memory (RAM) is in your computer? Does your computer support pen and touch input?

4. Click the **Change settings** link. If a User Account Control dialog box is displayed, click the **Continue** button. The System Properties dialog box is displayed (see **Figure 2–24**).

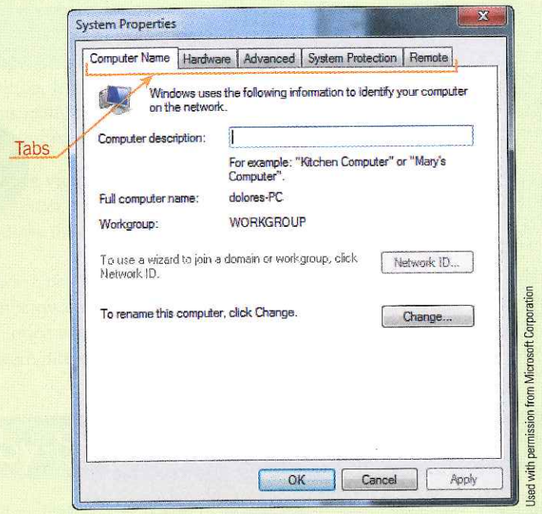


FIGURE 2–24
System Properties dialog box

5. Click each tab in the dialog box and read the information it contains. If directed by your instructor, use Notepad or your word-processing program and write an overview of the features in the System Properties dialog box.
6. Click the **OK** button to close the System Properties dialog box, and then close the System window.

ETHICS IN TECHNOLOGY

Computer Viruses

The word *virus* can put fear into anyone who uses the Internet or exchanges disks. How can such a small word cause such fear? It is because a virus can cause tremendous damage to your computer files!

A computer virus is a small software program that spreads from one computer to another and interferes with the operation of the computers. A virus is written to attach itself intentionally to other programs or to disk boot sectors and duplicates itself whenever those programs are executed or the infected disks are accessed. A virus can delete or corrupt data, delete everything on the hard drive, or spread the virus to other programs through e-mail.

Viruses can be stored on your computer for weeks or months and not cause any damage until a predetermined date or time code is activated. They are easily spread by e-mail attachments or downloaded files. Computer viruses can be disguised as attached greeting cards, audio and video files, or as other attachments. Not all viruses cause damage. Some are just pranks; your desktop might display a silly message or animation. Viruses are created by persons who are impressed with the power they possess because of their expertise in the area of computers; sometimes they create them just for fun. To protect your computer from virus damage, install an antivirus software program on your computer and keep it running at all times so that it can continuously scan for viruses.

SUMMARY

In this lesson, you learned:

- Input devices enable you to input data and commands into the computer. The most common input devices are the keyboard and mouse.
- Other types of input devices include the trackball, joystick, wheel, pointing stick, touch display screen, stylus, voice recognition device, touchpad, scanner, digital camera, video camera, and biometric scanner.
- Monitors and printers are examples of output devices. Monitors produce soft copy. Printers produce a paper or hard copy of the processed result.
- Criteria for selecting a printer include speed, print quality, and cost.
- Input and output devices must be connected to the computer. Some input and output devices communicate with the computer through a physical connection. Wireless devices communicate with the computer through infrared or radio waves.
- Peripheral devices can connect to the computer through serial, parallel, and Universal Serial Bus (USB) ports. USB is the current standard and replaces serial and parallel ports.
- FireWire is a type of external bus that can connect up to 63 external devices.
- SCSI, IrDA, and Bluetooth are special-purpose ports.
- A computer's performance is affected by the speed of the processor, the amount of RAM, hard disk size and speed, capability of monitor, and disk organization.

LESSON REVIEW

TRUE / FALSE

Circle T if the statement is true or F if the statement is false.

T F 1. Input devices enable the computer to give you the results of processed data.

T F 2. A trackball mouse is an upside-down mouse.

T F 3. The mouse is the most commonly used input device for entering data.

T F 4. Input and output devices can stand alone—they do not need to be connected to the computer.

T F 5. Keyboards can be wireless or cordless.

MULTIPLE CHOICE

Select the best response for the following statements.

1. Which of the following types of keyboards is designed to provide users with a more natural and comfortable hand, wrist, and arm position?
   A. security C. ergonomic
   B. cordless D. wireless
2. Which one of the following is a type of scanner that converts graphics into an electronic form?
   A. image scanner C. bar code scanner
   B. magnetic scanner D. OCR scanner
3. Most notebook computers contain a _____.
   A. pointing device or pointing stick
   B. media player
   C. printer
   D. digital camera
4. _____ produce an image by manipulating light within a layer of liquid crystal cells.
   A. LCD panels C. Scanners
   B. Gas plasma monitors D. CRT monitors
5. Which of the following is a biometric identification scanning technique?
   A. fingerprint C. voice
   B. face D. all of the above

FILL IN THE BLANK

Complete the following sentences by writing the correct word or words in the blanks provided.

1. A(n) _____ is the most widely used device for entering data into the computer.
2. A(n) _____ reads encoded information on the back of credit cards.
3. A person's fingerprint, face, handwriting, or voice can be used for _____ identification.
4. A(n) _____ combines various output options such as printing, scanning, copying, and faxing.
5. A(n) _____ port can connect up to 127 peripheral devices with a single connector.

PROJECTS

PROJECT 2–1

IC3 1-1.1.5

You are in the market for a new keyboard and want to research keyboards before purchasing one. Use Google or another search engine and review several different types of keyboards. Then select two of the keyboards that you would like to test. Describe each keyboard, describing similar characteristics and those that make the keyboards different. Determine which keyboard you would purchase for personal use and explain why you selected it. Press the Print Screen key to capture an image of the keyboard you selected and paste it in a document.

PROJECT 2–3

IC3 1-1.1.6

Digital cameras were one of the specialized devices discussed in this lesson. Review the section on digital cameras. Then use Google or another search engine to research digital cameras. Select at least five digital cameras that you would like to purchase. Describe the pros and cons of each camera and then indicate the one you would select to purchase. Explain why you selected this particular camera.

PROJECT 2–2

IC3 1-1.1.6

Biometric technology is the automated method of recognizing a person based on a physiological or behavioral characteristic. Use the Internet and other sources to research this topic.

1. Use your favorite search engine to search for Web pages discussing biometric technology.
2. Based on your findings, create a document listing the pros and cons of biometric technology. Include your personal opinion about this topic.
3. Submit the document to your instructor as requested.

TEAMWORK PROJECT

This exercise is a role-playing activity to dramatize how a computer works. Select one of the following roles to play: processor, main memory, storage device, or input/output device. Then select a specific task, such as (a) inputting pictures from a digital camera, modifying and viewing the pictures, and outputting and printing the pictures; (b) using word-processing software to create a report on a specified school topic, adding pictures to the report, and then printing copies for all students in the class; (c) using a spreadsheet program to create a worksheet and chart and then print copies for all students in the class; (d) using a presentation program such as PowerPoint to create a presentation with text, images, and video; then display the presentation to the class. Role-play parts of a computer to accomplish the task you select. Be prepared to play these roles in front of the class or your instructor.

CRITICAL THINKING

IC3 1-1.1.9

You want to learn more about how the computer processes data and the factors that control the processing speed. Your instructor thinks this is a great idea and asks you to prepare a report or a presentation on what factors produce the best processors. In the report or presentation, describe processing speed and how to influence and increase the speed.

ONLINE DISCOVERY

Gmail is a free Web mail service provided through Google. You can use Gmail to communicate with your classmates and instructor for this course. Complete the following steps to create an account.

1. Open your browser and go to *http://mail.google.com/mail/help/open.html*.
2. When the Welcome to Gmail screen is displayed, read the information provided on the page. Then click the **Create an account** button.
3. Type your first and last name and desired user name. Click the **check availability!** button to verify that the name is available.
4. Enter a password for accessing the account. Click the **Password strength** link to have Google assess the security of your password as poor, fair, or strong. Your goal is to create a strong password. It must be a minimum of eight characters. Be sure to write down your password or send the password to yourself in an e-mail. Re-enter the password to verify it.
5. If you are using a school computer or a computer other than your own, do not select the "Stay signed in," "Enable Web History," or "Set Google as my default homepage" check box.
6. Click the **Security question** arrow button, and then select a security question that you are sure to remember. Enter the answer and e-mail the answer to yourself.
7. If you have another e-mail address, you can enter it into the Recovery e-mail text box. However, this is not necessary or required.
8. Select your geographic location, such as United States. You can leave the Birthday field blank.
9. For Word Verification, type the characters displayed on the form.
10. Read the Terms of Service, and then click the **I accept. Create my account.** button.
11. When an Introduction to Gmail page is displayed, read the information on the page and then click **Show me my account**. Sign in to your account using your user name and password.
12. Click the **Compose mail** link and send a message to your instructor and another classmate. List three facts in the message that are related to the topics presented in this lesson. If requested by your instructor, print a copy of your message and submit it to your instructor.

For additional information, see *http://mail.google.com/support/*.

JOB SKILLS

In most jobs, particularly if you are working in a large company, managers want their employees' attention, energy, and drive focused on the company and its goals. The employee who is eager, reliable, and willing to do more than the usual tasks generally attracts the attention of managers. In most instances, that employee is more likely to get ahead. Use the Internet or other sources and research "working to get ahead." Write a paragraph or two describing the skills and characteristics successful employees have based on your findings. List the address or addresses of the Web sites where you located your information.

Estimated Time: 1 hour

LESSON 3

Computer Protection

OBJECTIVES

Upon completion of this lesson, you should be able to:

- Protect computer hardware from theft and damage.
- Safeguard data.
- Identify environmental factors that can damage computers.
- Protect computers from power loss and fluctuation.
- Identify common computer hardware problems.

DATA FILES

You do not need data files to complete this lesson.

WORDS TO KNOW

backup
data theft
driver
encryption
humidity
ping
power spikes
surge suppressor
uninterruptible power supply (UPS)