

INPUT AND OUTPUT: Extending Capabilities of Computers and Mobile Devices

7



“After work or school, I video chat with my friends and discuss our gaming strategies. I print photos from my digital camera on my ink-jet printer. I have a wireless speaker system that works with my laptop and phone. What more should I know about input and output?”

While you may be familiar with some of the content in this chapter, do you know how to . . .

- Decide if you should take notes electronically or by hand?
- Use motion and gestures for input?
- Use touch input on various devices?
- Use DV technology?
- Set up and use a webcam or integrated DV camera?
- Prevent unauthorized use of a webcam?
- Improve the quality of scanned documents?
- Scan QR codes safely?
- Prevent electronic pickpockets from obtaining information stored on your credit cards and other personal documents?
- Protect yourself from hardware radiation?
- Show media on a Smart TV from a computer or tablet?
- Print from a smartphone or tablet?
- Acquire assistive technologies for input and output?

In this chapter, you will discover how to perform these tasks along with much more information essential to this course. For additional content available that accompanies this chapter, visit the free resources and premium content. Refer to the Preface and the Intro chapter for information about how to access these and other additional instructor-assigned support materials.

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Users interact with a variety of input and output devices every day.





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Objectives

After completing this chapter, you will be able to:

- 1 Differentiate among various types of keyboards: standard, compact, on-screen, virtual, ergonomic, gaming, and wireless
- 2 Describe characteristics of various pointing devices: mouse, touchpad, and trackball
- 3 Describe various uses of touch screens
- 4 Describe various types of pen input: stylus, digital pen, and graphics tablet
- 5 Describe various uses of motion input, voice input, and video input
- 6 Differentiate among various scanners and reading devices: optical scanners, optical readers, bar code readers, RFID readers, magstripe readers, MICR readers, and data collection devices
- 7 Identify the types of output
- 8 Explain the characteristics of various displays
- 9 Summarize the various types of printers: ink-jet printers, photo printers, laser printers, all-in-one printers, thermal printers, mobile printers, label printers, plotters and large-format printers, and impact printers
- 10 Identify the purpose and features of speakers, headphones and earbuds, data projectors, interactive whiteboards, and force-feedback game controllers and tactile output
- 11 Identify various assistive technology input and output methods

What Is Input?

Input is any data and instructions entered into the memory of a computer. As shown in Figure 7-1, people have a variety of options for entering data and instructions into a computer.

As discussed in Chapter 1, *data* is a collection of unprocessed items, including text, numbers, images, audio, and video. Once data is in memory, a computer or mobile device interprets and executes instructions to process the data into information. Instructions that a computer or mobile device processes can be in the form of software (programs and apps), commands, and user responses.

- *Software* is a series of related instructions, organized for a common purpose, that tells a computer or mobile device what tasks to perform and how to perform them. When software developers write programs or apps, they usually enter the instructions into the computer or mobile device by using a keyboard, mouse, or other input method. The software developer then stores the program in a file that a user can execute (run). When a user runs a program or app, the computer or mobile device loads the program or app from a storage medium into memory. Thus, a program or app is entered into a computer's or mobile device's memory.
- A *command* is an instruction that causes a program or app to perform a specific action. Programs and apps respond to commands that a user issues. Users issue commands by touching an area on a screen, pressing keys on the keyboard, clicking a mouse button to control a pointer on the screen, or speaking into a microphone.
- A *user response* is an instruction a user issues by responding to a message displayed by a program or app. A response to the message instructs the program or app to perform certain actions. For example, when a program or app asks the question, 'Do you want to save the changes made to this file?', and you respond with the instruction of 'Yes', the program will save the file with the changes you made. If you respond with the instruction of 'No', the program will not save your changes before exiting.

Commonly used input methods include the keyboard, pointing devices, touch screens, pen input, motion input, voice input, video input, and scanners and reading devices. This chapter discusses each of these input methods.



Figure 7-1 Users can enter data and instructions into computers and mobile devices in a variety of ways.

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Keyboards

Most computers and mobile devices include a keyboard or keyboarding capabilities. As discussed in previous chapters, a **keyboard** is an input device that contains keys you press to enter data and instructions into a computer or mobile device. Nearly all keyboards have a typing area, function keys, toggle keys, and navigation keys (Figure 7-2). Many also include media control buttons, Internet control buttons, and other special keys. Others may include a fingerprint reader or a pointing device.

- The typing area includes letters of the alphabet, numbers, punctuation marks, and other basic keys. Read Secure IT 7-1 to learn about software that can track your keystrokes.
- *Function keys*, which are labeled with the letter F followed by a number, are special keys programmed to issue commands to a computer. The command associated with a function key may vary, depending on the program you are using.
- A *toggle key* is a key that switches between two states each time a user presses the key. CAPS LOCK and NUM LOCK are examples of toggle keys. Many mobile devices have keys that toggle the display of alphabetic, numeric, and symbols on touch keyboards in order to display more characters and symbols on a keyboard with fewer keys.
- Users can press the navigation keys, such as arrow keys and PAGE UP/PG UP and PAGE DOWN/PG DN on the keyboard, to move the insertion point in an application left, right, up, or down.
- A *keyboard shortcut* is one or more keyboard keys that you press to perform an operating system or application-related task. Some keyboard shortcuts are unique to a particular application or operating system.
- Media control buttons allow you to control a media player program, access the computer's optical disc drive, and adjust speaker volume.
- Internet control buttons allow you to run an email application, run a browser, and search the web.

Discover More: Visit this chapter's free resources to learn more about function key commands, toggle keys, and keyboard shortcuts.



Insertion Point

The *insertion point*, also known as a *cursor* in some applications, is a symbol on the screen, usually a blinking vertical bar, that indicates where the next character you type will appear.

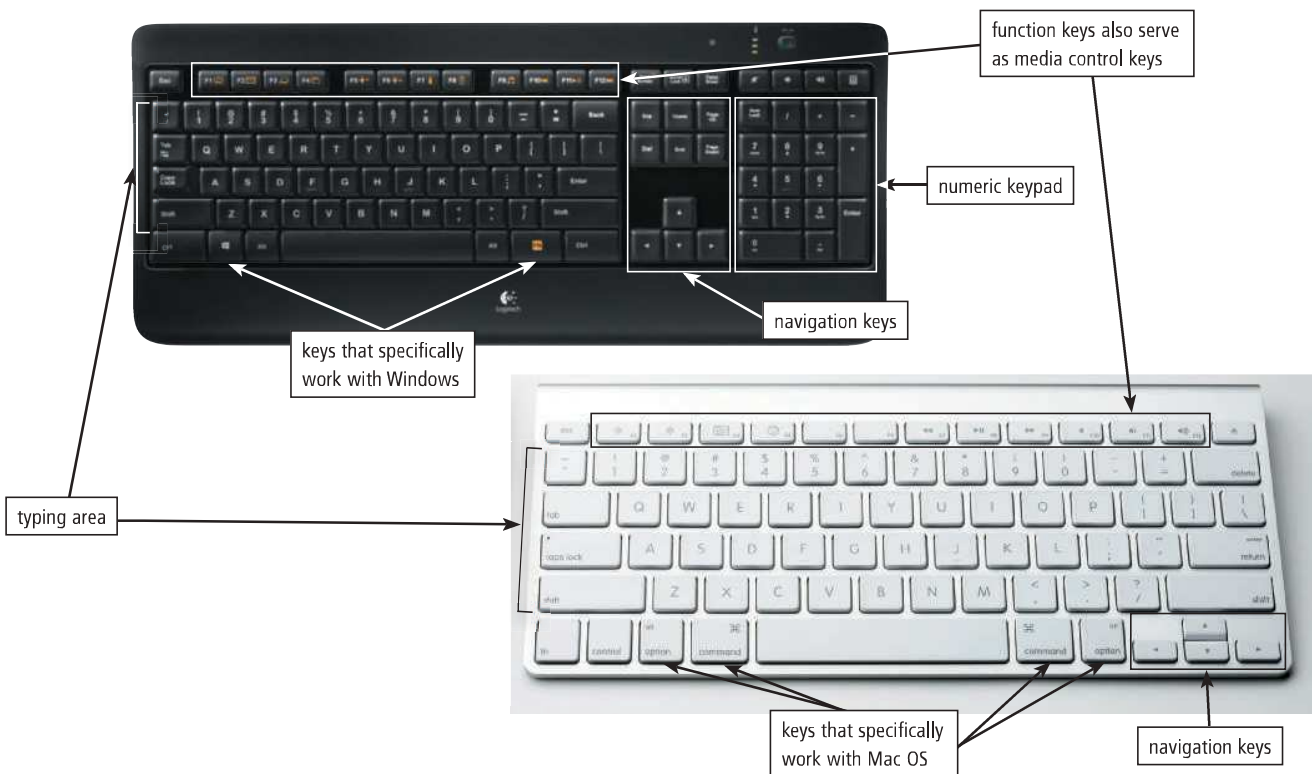


Figure 7-2 On a standard keyboard, you type using keys in the typing area and on the numeric keypad. Some of the keys on standard keyboards differ, depending on the operating system with which they are designed to work.

Courtesy of Logitech; © iStockphoto / Jill Fromer

SECURE IT 7-1

Keyboard Monitoring

Some employers and parents want to monitor everything that has been entered into a computer to ensure that employees and children are using the computer for appropriate purposes. They may use *keyboard monitoring software*, also called *keylogging software*, to accomplish this task. This software runs undetected and stores every keystroke in a file for later retrieval.

These programs have both criminal and beneficial purposes. When used in a positive fashion, employers can measure the efficiency of data entry personnel. This software also can verify that employees are not releasing company secrets, are not viewing personal or inappropriate content on work computers, and are not engaging in activities that could subject the company to harassment, hacking, or other similar charges. Employers sometimes use the software to troubleshoot technical problems and to back up their networks. Parents, likewise, can verify their children are using the home computer safely and are not visiting inappropriate websites. Educators and

researchers can capture students' input to analyze how well they are learning a second language or improving their typing skills. This software also can monitor activity in chat rooms and other similar locations.

When used for malicious purposes, criminals use the programs on both public and private computers to capture user names, passwords, credit card numbers, and other sensitive data and then use this data to access financial accounts and private networks.

Many keylogging programs are available, and they perform a variety of functions. Some simply record keystrokes in a hidden file stored on the hard drive that can be accessed by supplying the correct password. More sophisticated programs record software used, websites visited, and periodic screenshots and then transmit this data to a remote computer.

It can be difficult to locate keylogging software on a computer, but taking these steps may help detect the programs:

- **Run detection software regularly.** Several antivirus and spyware detection programs check for known keylogging programs.
- **Review hard drive files.** Regularly look at the most recent files and note any that are updated continually. These files might be the keylogging software's logs.
- **Check running programs.** Periodically examine which software is loaded from the computer's hard drive into memory when you start the computer and which are running while you are using the computer. If you are uncertain of any program names, perform a search to learn the software's function and if it is a known keylogging program.

Consider This: Do you know anyone who has installed keylogging software or who has found keylogging software installed on his or her computer? Is keylogging software an invasion of privacy? Should employers inform employees if the software is installed? Why or why not?

Types of Keyboards

Desktops include a standard keyboard. Standard keyboards typically have from 101 to 105 keys, which include function keys along the top and a numeric keypad on the right (shown in the top keyboard in Figure 7-2).

As discussed in previous chapters, you have a variety of keyboard options for mobile computers and devices (Figure 7-3). These devices often use a *compact keyboard*, which is smaller than a standard keyboard and usually does not include the numeric keypad or navigation keys. Typically, the keys on a compact keyboard serve two or three purposes in order to provide the same functionality as standard keyboards. Some compact keyboards are built into the computer or mobile device and/or are permanently attached with hinges, a sliding mechanism, or some other technique. Other compact keyboards are separate devices that communicate wirelessly or attach to the computer or device with a magnet, clip, or other mechanism. Some users prefer to work with on-screen or virtual keyboards instead of a physical keyboard. Others, however, prefer to use a standard keyboard with their mobile devices because these keyboards provide added functionality and tactile comfort.

CONSIDER THIS

What is the rationale for the arrangement of keys in the typing area?

The keys originally were arranged on old mechanical typewriters to separate frequently used keys, which caused typists to slow down. This arrangement, called a QWERTY keyboard because the six first letters on the top row of letter keys spell QWERTY, reduced the frequency with which the mechanical levers jammed.



Figure 7-3 Users have a variety of keyboard options for mobile computers and devices.

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Figure 7-4 An ergonomic keyboard.
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An *ergonomic keyboard* has a design that reduces the chance of repetitive strain injuries (RSIs) of wrist and hand (Figure 7-4). Recall that the goal of ergonomics is to incorporate comfort, efficiency, and safety in the design of the workplace. Even keyboards that are not ergonomically designed attempt to offer a user more comfort by including a wrist rest.

A *gaming keyboard* is a keyboard designed specifically for users who enjoy playing games on the computer. Gaming keyboards typically include programmable keys so that gamers can customize the keyboard to the game being played.

The keys on gaming keyboards light up so that the keys are visible in all lighting conditions. Some have small displays that show important game statistics, such as time or targets remaining.

Internet Research

How prevalent are RSIs?

Search for: rsi statistics



CONSIDER THIS

Why use a wireless keyboard?

Although some keyboards connect via a cable to a USB port on the computer, some users choose a wireless keyboard to eliminate the clutter of a cord and/or to free USB ports for other uses. A *wireless keyboard* is a battery-powered device that transmits data to the computer or mobile device using wireless technology. For example, Bluetooth keyboards are especially popular with tablets because they do not require a USB port and are easy to pair with computers and devices. Many vendors offer tablet cases with a built-in Bluetooth keyboard so that you easily can transport a keyboard with the tablet.



Technology Innovator

Discover More: Visit this chapter's free resources to learn about Logitech, a global company that makes a variety of input and output devices.

Pointing Devices

In a graphical user interface, a **pointer** is a small symbol on the screen whose location and shape change as a user moves a pointing device. A pointing device can enable you to select text, graphics, and other objects, such as buttons, icons, links, and menu commands. The following pages discuss a variety of pointing devices.

Mouse

A **mouse** is a pointing device that fits under the palm of your hand comfortably. As you move a mouse, the pointer on the screen also moves. The bottom of a mouse is flat and contains a mechanism that detects movement of the mouse. Desktop users have an optical mouse or a touch mouse, both of which can be placed on nearly all types of flat surfaces (Figure 7-5).

An *optical mouse* uses optical sensors that emit and sense light to detect the mouse's movement. Similarly, a *laser mouse* uses laser sensors that emit and sense light to detect the mouse's movement. Some mouse devices use a combination of both technologies. The top and sides of an optical or laser mouse may have one to four buttons; some may also have a small wheel. Some are more sensitive than others for users requiring more precision, such as graphic artists, engineers, or game players.

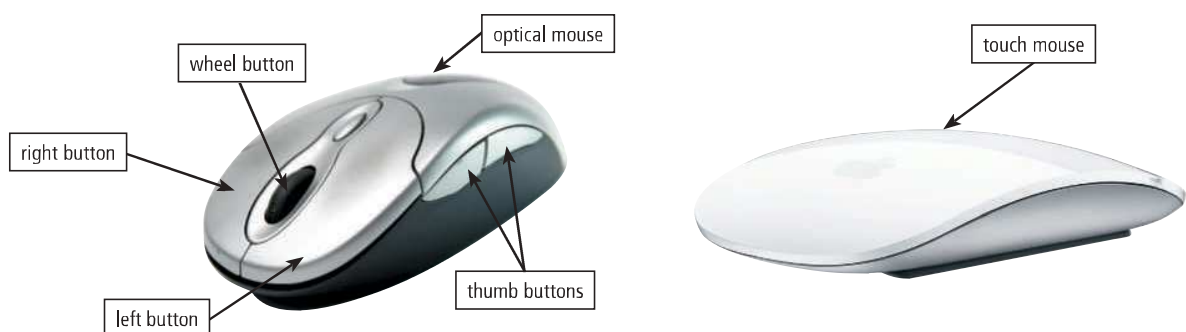


Figure 7-5 An optical mouse has buttons. A touch mouse often has no buttons.

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A *touch mouse* is a touch-sensitive mouse that recognizes touch gestures, in addition to detecting movement of the mouse and traditional click and scroll operations. For example, you press a location on a touch mouse to simulate a click, sweep your thumb on the mouse to scroll pages, or slide multiple fingers across the mouse to zoom.

As with keyboards, you can purchase an ergonomic mouse to help reduce the chance of RSIs or to reduce pain and discomfort associated with RSIs.

CONSIDER THIS

Why use a wireless mouse?

As with keyboards, some users choose a wireless mouse to eliminate the clutter of a cord. A *wireless mouse* is a battery-powered device that transmits data using wireless technology. A wireless mouse typically transmits data to a receiver that plugs in a USB port or uses Bluetooth technology to pair with the device.

Touchpad

A **touchpad** is a small, flat, rectangular pointing device that is sensitive to pressure and motion (Figure 7-6). Touchpads are found most often on laptops and convertible tablets. Desktop users who prefer the convenience of a touchpad can purchase a separate touchpad, which usually communicates wirelessly with the computer.

To move the pointer using a touchpad, slide your fingertip across the surface of the pad. Some touchpads have one or more buttons around the edge of the pad that work like mouse buttons; others have no buttons. On most touchpads, you also can tap the pad's surface to imitate mouse operations, such as clicking. Some touchpads also recognize touch gestures, such as swipe, pinch, and stretch motions.



Trackpad

Apple uses the term, *trackpad*, to refer to the touchpad on its laptops.



Figure 7-6 Laptop users often use the touchpad to control movement of the pointer. You also can purchase an external wireless touchpad for use with desktops and tablets.

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CONSIDER THIS

What is a pointing stick?

Some mobile computer keyboards contain a pointing stick, which is a pressure-sensitive pointing device shaped like a pencil eraser positioned between its keys. To move the pointer using a pointing stick, you push the pointing stick with a finger.

Trackball

A **trackball** is a stationary pointing device with a ball on its top or side. The ball in most trackballs is about the size of a Ping-Pong ball. Some devices, called a trackball mouse, combine the functionality of both a trackball and a mouse (Figure 7-7).

To move the pointer using a trackball, you rotate the ball with your thumb, fingers, or the palm of your hand. In addition to the ball, a trackball usually has one or more buttons that work like mouse buttons.



CONSIDER THIS

Why use a trackball instead of a mouse?

For users who have limited desk space, a trackball is a good alternative to a mouse because the device is stationary. Keep in mind, however, that a trackball requires frequent cleaning because it picks up oils from fingers and dust from the environment.



Figure 7-7 Shown here is a trackball mouse, which is a single device that provides the functionality of both a trackball and a mouse.

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Touch Screens

A **touch screen** is a touch-sensitive display. Touch screens are convenient because they do not require a separate device for input. Smartphones and tablets, and many laptops and all-in-ones offer touch screens.

You can interact with a touch screen by touching areas of the screen with your finger or a stylus to make selections or to begin typing. Many touch screens also respond to gestures. A *gesture* is a motion you make on a touch screen with the tip of one or more fingers or your hand. For example, you can slide your finger to drag an object or pinch your fingers to zoom out. (Read How To 1-1 in Chapter 1 for a description of widely used touch screen gestures.)

Touch screens that recognize multiple points of contact at the same time are known as *multi-touch*. Because gestures often require the use of multiple fingers (points of contact), touch screens that support gestures are multi-touch.



High-Tech Talk

Discover More: Visit this chapter's free resources to learn about biometric input.

Mini Feature 7-1: Touch Input

Many new computers and devices are using touch as a primary method of input. In fact, newer operating systems are optimizing their user interfaces for touch input. Read Mini Feature 7-1 to learn about various devices that use touch input.

MINI FEATURE 7-1

Touch Input

Devices that utilize touch input include monitors for desktops and screens on laptops and tablets, smartphones, wearable devices, portable media players, digital cameras, tablets, kiosks, and navigation systems.

Desktop Monitors and Screens on Laptops and Tablets

An increasing number of desktop monitors and screens on laptops and tablets support touch input. These touch-enabled monitors and screens allow users to interact with the operating system without a keyboard or pointing device. Instead of using a mouse to click an object on the screen, users simply can tap or double-tap the item they otherwise would have clicked. For example, users can tap or double-tap an icon to run a program or an application, slide their finger to scroll, or use their finger to drag items across the screen.



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© iStockphoto / urbantcov

Smartphones

Smartphones are becoming more functional, lighter weight, and now often do not include a physical keyboard. Touch input can help smartphone manufacturers achieve all these goals. The gestures you might perform on a smartphone that supports touch input include tapping to run an app, sliding or swiping to scroll, and pinching and stretching to zoom. The absence of a physical keyboard makes it more difficult to type without looking at the screen, so it is not advisable to use a smartphone when performing actions that require undivided attention, such as driving a car or walking.

Wearable Devices

Wearable devices, such as smartwatches, do not have room for a physical keyboard, so they mainly rely on touch input. The gestures you might perform on a wearable device include tapping to make a selection, and sliding or swiping to scroll through the various screens.

Portable Media Players

Portable media players widely use touch as the primary method of input so that the size of the screen on the device is maximized. That is, space on the device does not have to be dedicated to other controls, such as buttons or click wheels. Users slide and swipe to browse their music libraries on their portable media players and then tap to select the song they want to play. While songs are playing, users can tap the screen to display controls so that they can pause or stop the song, navigate to another song, or adjust the volume.

Digital Cameras

As digital cameras start to include built-in features to browse through and edit photos without requiring a computer, touch input helps digital camera users perform these functions with greater accuracy. For example, you can perform gestures such as swiping left and right on the screen to browse your photos, tapping the screen to identify the area on which you wish to focus when taking a picture, pinching and stretching to zoom while viewing photos, tapping areas of photos to remove red-eye, and dragging borders of photos to crop them.

Kiosks

Touch input also is used on devices where a keyboard and pointing device might not endure its high volume of use. Kiosks, such as those at an airport allowing you to check in for a flight, can be used by hundreds of people per day. Because kiosks are designed to help you perform a specific function as quickly as possible, touch input is ideal for their user-friendly interfaces. Users typically interact with kiosks by tapping various areas of the screen to select options (as discussed in Chapter 3). If typing is required, an on-screen keyboard is displayed so that users can enter information, such as their name or a confirmation number. Kiosks requiring sensitive or a significant amount of input also might include a separate keyboard and pointing device. For example, ATMs with touch screens often have a separate keypad to enter your PIN so that others are not able to see what you are typing.

Navigation Systems

Navigation systems in cars and other vehicles use touch input because typing on a separate keyboard is not wise while in a vehicle. Navigation system users can perform actions such as tapping to enter a destination address, dragging to display different areas of the map, or pinching and stretching to zoom. Operating a navigation system with touch input requires you to take your eyes off the road to interact with the device, so you should operate a navigation system only while your vehicle is parked or stopped. To reduce the chances of driver distraction, some built-in navigation systems reduce functionality while the vehicle is in motion. Read Ethics & Issues 7-1 to consider issues associated with using navigation and other mobile devices while driving.

Discover More: Visit this chapter's free resources to learn more about operating systems, monitors, smartphones, portable media players, and navigation systems that use touch input.

Consider This: Do you find it is easier to use touch input instead of using a keyboard or mouse? Does your answer depend on the type of device you are using or the task you are trying to accomplish? Why?



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ETHICS & ISSUES 7-1

Should a Vehicle Be Able to Prevent User Input on a Mobile Device while the Vehicle is in Motion?

As you are driving, you receive a text message from a friend. Is it safe to read the text message? Is it legal? Should you respond to it? Millions of Americans acknowledge that they use mobile phones while driving. Today's newer vehicles include sophisticated hands-free systems that use Bluetooth and other technologies to connect mobile devices to the vehicle's sound system.

Other technologies restrict or block usage while a vehicle is moving. Motion sensors can detect if the car is in motion. A phone's camera can tell whether the user is the driver or a passenger by the angle of the scenery in the

background. Some cars will not start unless the mobile device is plugged into a socket that blocks all signals and can send a message to a parent if the device is removed. Parents can install apps on their children's smartphones that use GPS, cameras, and motion sensors to track or restrict teens' usage.

The debate about mobile phone safety while driving elicits different points of view from vehicle insurance companies, consumer safety groups, and the telecommunications industry. The U.S. Department of Transportation says that users who text while driving have a crash risk 23 times higher than those who refrain. In some states, it is illegal to send, read, or respond to text messages while driving. Other states have outlawed the use of mobile phones or they

require drivers to use hands-free devices while driving. Many states have different laws for teens or new drivers.

A recent study stated that talking on a phone while driving affects drivers' response times as much as if they had consumed alcohol. Critics of hands-free and signal blocking technology claim that drivers can be just as easily distracted if they are discussing business or emotional matters.

Consider This: Would you use technology that limited your device usage while driving? Why or why not? Do you think laws that target teens or new drivers are fair? Why or why not? Do you believe hands-free devices are safe? Why or why not?

CONSIDER THIS

What is the purpose of a touch-sensitive pad?

Portable media players that do not have touch screens typically have a touch-sensitive pad. A *touch-sensitive pad* is an input device that contains buttons and/or wheels you operate with a thumb or other finger. Using the touch-sensitive pad, you can scroll through and play music; view photos; watch videos or movies; navigate through song, photo, or movie lists; display a menu; adjust volume; customize settings; and perform other actions. For example, users can rotate a portable media player's touch-sensitive pad to browse through the device's playlists and press the pad's buttons to play or pause media (Figure 7-8).

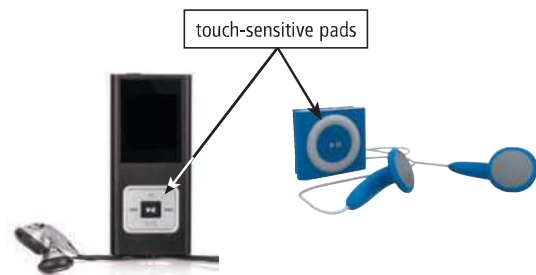


Figure 7-8 You use your thumb or finger to rotate or press buttons on a touch-sensitive pad, which commonly is found on portable media players.

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Pen Input

Some displays and mobile devices support pen input. With **pen input**, you touch a stylus or digital pen on a flat surface to write, draw, or make selections.

Stylus

A **stylus** is a small metal or plastic device that looks like a tiny ink pen but uses pressure instead of ink (Figure 7-9). Nearly all tablets and mobile devices, some laptop screens, and a few desktop monitors have touch screens that support pen input, in addition to touch input. These computers and devices may include a stylus. Some stylus designs include buttons you can press to simulate clicking a mouse.

To capture a handwritten signature, a user writes his or her name on a **signature capture pad** with a stylus that is attached to the device. Software then transmits the signature to a central computer, where the signature is stored. Retailers use signature capture pads to record purchasers' signatures. Signature capture pads often work with POS terminals and include a magnetic stripe card reader, discussed later in the chapter.



Stylus

Some manufacturers refer to a stylus as a pen.



Figure 7-9 You use a stylus to write, draw, or make selections on a touch screen that supports pen input.

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Digital Pen

A **digital pen**, which is slightly larger than a stylus, is an input device that captures and converts a user's handwriting or drawings into a digital format, which users can upload (transfer) to a computer or mobile device. Some require the user to write or draw on special paper or a tablet; others can write or draw on any surface (Figure 7-10).

Once uploaded, *handwriting recognition software* on the computer or mobile device translates the handwritten letters and symbols created on the screen into typed text or objects that the computer or device can process. For this reason, digital pens most often are used for taking notes. Some are battery operated or USB powered; others use wireless technology, such as Bluetooth. Read Ethics & Issues 7-2 to consider whether you should take notes electronically or by hand.

Discover More: Visit this chapter's free resources to learn more about digital pens.



Figure 7-10 Users take notes with a digital pen and then upload the notes to a computer or mobile device, where software translates the notes to typed text.

Courtesy of LiveScribe

Internet Research

Which digital pens are the most accurate?

Search for: digital pen reviews

ETHICS & ISSUES 7-2

Is It More Efficient to Take Notes by Hand or with a Digital Device?

When an instructor starts a lecture, he or she looks out at the classroom to see some students bent over a tablet, others frantically typing on a laptop, and still others using pen and paper to take notes. Which method is most effective for retaining knowledge?

A recent study concluded that students who used traditional pen and paper to take notes in class and while studying had better understanding and recall of information. The study concluded that when taking notes on a laptop, students tended to write down the speaker's exact words. Taking notes longhand required students to process the information, use their own words, and select

what information is important enough to write down. Tablet users tended to have a mix of both transcribed and selected content. Regardless of the note-taking method, students performed equally when asked to recall factual information. Laptop users, however, were less able to answer conceptual or interpretive questions than those who took notes longhand.

Another concern when using laptops and mobile devices in a classroom is distractibility. Students may receive notifications about activity on an online social network, or use Internet messaging or text messaging to communicate with others about unrelated topics. Research shows that laptop users have unrelated programs or apps on their screen up to 40 percent of class time. Many instructors

encourage students to use their computers and mobile devices for class related purposes. For example, some encourage students to Tweet answers to questions or research articles to support a fact or opinion. Others provide access to online forums in order for students to communicate with one another during or after class.

Consider This: Should instructors inform students about the benefits of longhand note taking? Why or why not? Should students be required to take notes longhand? Why or why not? How else might you use your computer or mobile device during class time to further your own learning?

Graphics Tablet

To use pen input on a computer that does not have a touch screen, you can attach a graphics tablet to the computer. A **graphics tablet**, also called a *digitizer*, is an electronic plastic board that detects and converts movements of a stylus or digital pen into digital signals that are sent to the computer (Figure 7-11). Each location on the graphics tablet corresponds to a specific location on the screen. Architects, mapmakers, designers, and artists, for example, use graphics tablets to create images, sketches, or designs.

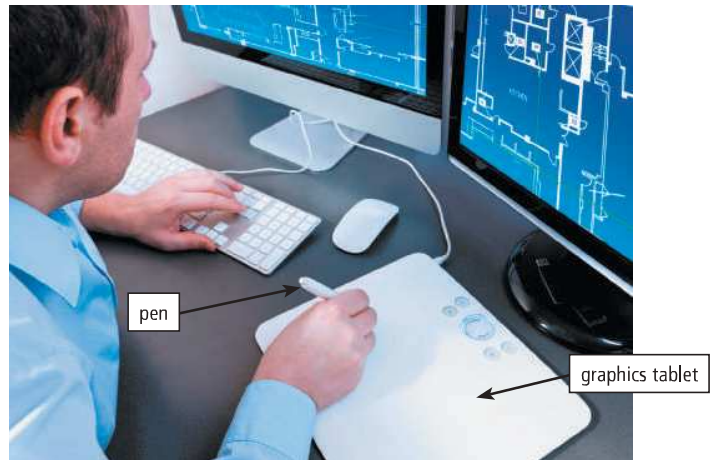


Figure 7-11 Architects use a graphics tablet to create blueprints.
© iStockphoto / small_frog

NOW YOU SHOULD KNOW

Be sure you understand the material presented in the sections titled What is Input?, Keyboards, Pointing Devices, Touch Screens, and Pen Input, as it relates to the chapter objectives.

Now you should know . . .

- What types of keyboards are available for computer and mobile devices, and which are best suited your needs (Objective 1)
- When you would use a mouse, touchpad, and trackball (Objective 2)
- What devices use touch screens (Objective 3)
- When you might use a stylus, digital pen, and graphics tablet (Objective 4)

Discover More: Visit this chapter's premium content for practice quiz opportunities.

Motion, Voice, and Video Input

Many of today's computers, mobile devices, and game devices support motion, voice, and video input. The following sections discuss each of these input methods.

Mini Feature 7-2: Motion Input

With *motion input*, sometimes called *gesture recognition*, users can guide on-screen elements using air gestures. *Air gestures* involve moving your body or a handheld input device through the air. With motion input, a device containing a camera detects your gesture and then converts it to a digital signal that is sent to a computer, mobile, or game device. For example, gamers can swing their arm or a controller to simulate rolling a bowling ball down a lane toward the pins. Read Mini Feature 7-2 to learn how a variety of fields use motion input.

Internet Research

What are other uses of gesture recognition?

Search for: gesture recognition uses

MINI FEATURE 7-2

Motion Input

Until a few years ago, the idea of controlling a computer by waving your hands was seen only in Hollywood science fiction movies. Today, the entertainment industry (such as for gaming and animating movies), the military, athletics, and the medical field have found uses for motion input.

Motion-sensing devices communicate with a game console or a personal computer using wired or wireless technology. The console or computer translates a player's natural gestures, facial movements, and full-body motion into input. Although these devices originally were intended for gaming, developers are working on adapting them or using similar technology outside of the gaming and entertainment industries.

Entertainment

Motion-sensing game controllers enable a user to guide on-screen elements by moving a handheld input device through the air. Examples include handheld devices that enable gamers to use sweeping arm movements to simulate sports activities, such as a golf swing (shown in the figure below), balance boards that judge stability and motion when holding yoga poses, and remote control attachments, such as a steering wheel used to guide a car along a race course.

Some controllers track peripheral motion within a specific area. With these devices, users can move their finger to draw or move their whole body to dance or exercise. Some use a device that can track small finger gestures, enabling users to be more precise in their movements.

Facial motion capture converts people's facial movements into a digital format while they talk, smile,

and more. Animators, for example, use the digital data to simulate facial movements to create realistic gaming avatars, or computer-generated characters in movies. Facial movements, however, are more subtle and difficult to detect. Thus, the technology used for capturing facial motions requires more precision and a higher resolution than that required by gaming devices.

Military

Military uses of motion input include training, such as flight simulation or weapon usage. To ensure safety, trainees maneuver a helicopter or other device using motion input from a remote location. Motion input also aids in physical rehabilitation for wounded soldiers by providing a method for conducting physical therapy exercises outside of a military hospital. Another use of motion input is to assist in recovery from post-traumatic stress disorder. Sufferers of this ailment can use avatars and simulators to work through scenarios in a comfortable environment.

Athletics

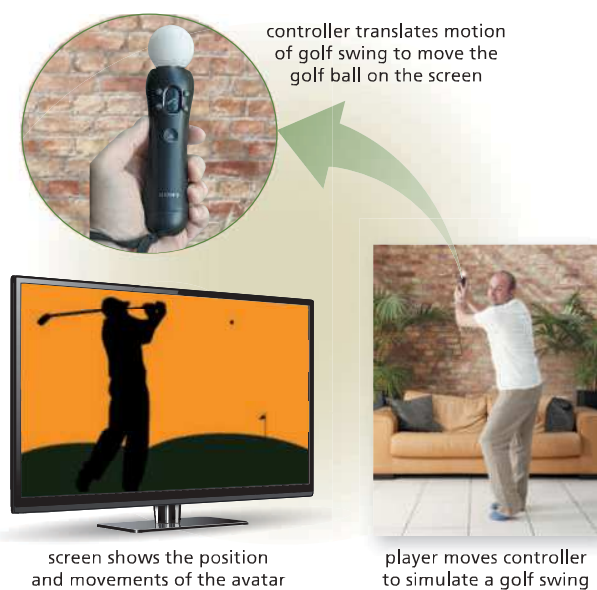
Coaches and sports trainers use motion input to improve athletes' performance and to correct inefficient or injury-causing motions. Analyzing the arc of a pitcher's arm, and factoring the speed of the motion and the trajectory of the ball, can help improve a pitcher's accuracy and speed. Combining the athlete's motion input with complex algorithms can pinpoint areas in which the athlete can improve.

Medical Field

The medical field also uses motion input for training. For example, surgeons can practice new technologies in a simulated environment. Using motion input that enhances movements, surgeons also can operate less invasively. Surgeons even operate remotely, enabling experts to manipulate surgical devices and share their expertise to save lives around the world. Sports medicine specialists use motion input to assess injuries, determine treatment, and assist in physical therapy.

Discover More: Visit this chapter's free resources to learn more about motion-sensing devices and controllers, controllers that track peripheral motion, and other uses of motion input.

Consider This: Have you used a motion-sensing device or game controller? What were your impressions? What security issues surround military use of motion input? What issues might the medical field encounter when using motion input?



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Figure 7-12 With Siri, you can speak instructions and commands to the smartphone and its apps. As shown here, the user asks Siri about the weather, to which Siri replies by speaking a message and displaying the forecast.

© iStockphoto / alexander kirch

Internet Research

How accurate is voice recognition?

Search for: voice recognition accuracy

Voice and Audio Input

Voice input is the process of entering input by speaking into a microphone. The microphone may be built in the computer or device, in a headset, or an external peripheral device that sits on top of a desk or other surface. Some external microphones have a cable that attaches to a port on a computer; others communicate using wireless technology, such as Bluetooth.

Uses of voice input include Internet messaging that supports voice conversations, chat rooms that support voice chats, video calls, videoconferencing, VoIP, and voice recognition. Recall that VoIP enables users to speak to other users via their Internet connection. **Voice recognition**, also called *speech recognition*, is the computer or mobile device's capability of distinguishing spoken words. Some computers and mobile devices make use of built-in and third-party voice recognition applications, which have a natural language interface (Figure 7-12). A *voice recognition application* allows users to dictate text and enter instructions by speaking into a microphone.

On mobile devices, these applications allow users to speak simple, task-based instructions to the device, such as setting an alarm, entering a calendar appointment, or making a call. Some mobile devices have a *speech-to-text* feature, which recognizes a user's spoken words and enters them into email messages, text messages, or other applications that support typed text entry.

Discover More: To learn how voice recognition works, visit the free resources in Chapter 3 and read the High-Tech Talk article on this topic.

Audio Input Voice input is part of a larger category of input called audio input. *Audio input* is the process of entering any sound into the computer, such as speech, music, and sound effects. To enter high-quality sound into computer, the computer uses a sound card or integrated sound capability. Users enter sound into computers and mobile devices via devices such as microphones, CD/DVD/Blu-ray Disc players, or radios, each of which plugs in a port on the computer or device.

Some users also record live music and other sound effects into a computer by connecting external music devices, such as an electronic keyboard (Figure 7-13), guitar, drums, harmonica, and microphones, to a computer. Music production software allows users to record, compose, mix, and edit music and sounds. For example, music production software enables you to change the speed, add notes, or rearrange the score to produce an entirely new arrangement.

Discover More: Visit this chapter's free resources to learn more about voice recognition applications and music production software.



Figure 7-13 This sound engineer uses a computer to mix music.

© iStockphoto / Chris Schmidt

CONSIDER THIS

How do external music devices connect to a computer?

External music devices typically connect to USB and MIDI ports. When purchasing a music device, check its specifications for the type(s) of ports to which it connects.

BTW

Technology Trend

Discover More: Visit this chapter's free resources to learn about the use of drones with technology.

Mini Feature 7-3: Digital Video Technology

Video input is the process of capturing full-motion images and storing them on a computer or mobile device's storage medium, such as a hard disk or optical disc. A **digital video (DV) camera** records video as digital signals, which you can transfer directly to a computer or mobile device with the appropriate connection. Read Mini Feature 7-3 to learn the steps involved in using DV technology.

MINI FEATURE 7-3

Digital Video Technology

Everywhere you look, people are capturing videos using DV (digital video) cameras and mobile devices with built-in digital cameras. Using **DV technology**, you can input, edit, manage, publish, and share your videos. You can enhance digital videos by adding scrolling titles and transitions, cutting out or adding scenes, and adding background music and voice-over narration. The following sections outline the steps involved in the process of using DV technology.

Step 1: Select a DV Camera

DV cameras range from inexpensive consumer versions to high-end DV camera models that support Blu-ray or HDV standards. Many mobile devices allow you to record digital video that you later can transmit to your computer or email from the device. When selecting a DV camera, consider features such as zoom, sound quality, editing capabilities, and resolution.

Step 2: Record a Video

With most DV cameras, you have a choice of recording programs that include different combinations of camera settings. These programs enable you to adjust the exposure and other functions to match the recording environment. You also have the ability to select special digital effects, such as fade, wipe, and black and white.

Step 3: Transfer and Manage Videos

You can connect most video cameras and mobile devices to a computer using a USB port. With many devices, you can transfer the videos to a media sharing or an online social network. Before doing this, however, consider the frame rate and video file format. The *frame rate* of a video refers to the number of frames per second (fps). A smaller frame rate results in a smaller file size for the video, but playback of the video will not be as smooth as one recorded with a higher frame rate. A video file format holds the video information in a manner specified by a vendor.

Step 4: Edit a Video

When editing, you first split the video into smaller pieces, or scenes, that you can manipulate easily. Most video editing software automatically splits the video into scenes at locations that you specify. After splitting, you should delete, or prune, unwanted scenes or portions of scenes. You can crop (or resize) scenes, and add logos, special

effects, or titles. Special effects include warping, changing from color to black and white, morphing, or zoom motion. *Morphing* transforms one video image into another image over the course of several frames of video.

The next step is to add audio effects, including voice-over narration and background music. Using many video editing programs, you can add more tracks, or layers, of sound to a video in addition to the sound that the video camera or mobile device recorded. Adding audio tracks enables you to set a mood by providing background music or sounds. In the final step, you use video editing software to combine the scenes into a complete video by ordering scenes and adding transition effects. Transition effect options include fades, wipes, blurs, bursts, ruptures, and erosions.

Step 5: Distribute a Video

Some mobile devices allow you to upload video directly to video sharing and online social networks, as well as to send a video message. You can save digital video to media such as a DVD or Blu-ray Disc and package it for individual distribution or sale.

Discover More: Visit this chapter's free resources to learn more about DV cameras, Blu-ray and HDV standards, special digital effects, transferring videos to a computer or online site, video file formats, video editing software, and adding logos.


 **Consider This:** If your computer or mobile device is capable of recording video, how often and for what purposes do you generally record videos? What settings can you adjust to improve the quality of the video? Which file format does your mobile device use to save video files?





Figure 7-14 During a video call, users see one another as they communicate.

© iStockphoto / Anatcliy Babiy

Webcams and Integrated DV Cameras

A **webcam** is a type of DV camera that enables you to capture video and still images, and usually audio input, for viewing or manipulation on a computer or mobile device. Some webcams are separate peripheral devices, which usually attach to the top of a desktop monitor. Many laptops, tablets, and smartphones have built-in webcams. Smartphones and other mobile devices have built-in integrated DV cameras. Read How To 7-1 for instructions about setting up and using a webcam or integrated DV camera.

Using a webcam or integrated DV camera, you can send email messages with video attachments, broadcast live images or video over the Internet, conduct videoconferences, and make video calls. During a **video call**, all parties see one another as they communicate over the Internet (Figure 7-14).

HOW TO 7-1

Set Up and Use Webcams and Integrated DV Cameras

As mentioned, webcams and DV cameras are used to record and/or send live video to others. Before you can record and send video to others, you must have a webcam or integrated DV camera on your computer or mobile device. Some computers and mobile devices have integrated DV cameras; others require you to set up a separate webcam. The following steps describe how to set up a webcam, and use a webcam or integrated DV camera:

Setting Up a Webcam

1. If the webcam included software, install the software on your computer before connecting the webcam.
2. Connect the webcam to your computer or mobile device either when the software prompts you or after you have installed the necessary software. If no software accompanied your webcam, connect the webcam to the computer or mobile device.
3. When the computer or mobile device acknowledges that a webcam has been connected, you are ready to begin using it.



Yuganov Konstantin / Shutterstock.com

Using a Webcam or Integrated DV Camera

1. Run the app that will use the webcam or integrated DV camera.
2. Display the app's settings and make sure the app recognizes the webcam or integrated DV camera.
3. If you are using the camera to record a video, record a short clip and then replay it to make sure the camera properly captured audio and video. If you are using the camera for a videoconference, place a call to somebody using the videoconferencing app and make sure he or she is able to see and hear you.

4. If you experience problems with the camera capturing audio or video, try the following:
 - a. Run the program that came with the camera and see if a troubleshooter can identify and correct the problem you are experiencing.
 - b. If you are using a webcam, disconnect the webcam from the computer, restart the computer or mobile device, and then reconnect the webcam.
 - c. If you are using a webcam, disconnect the webcam, uninstall the program(s) included with the webcam, restart the computer or mobile device, and then follow the previous steps to set up and use the webcam.
 - d. If you continue experiencing problems after attempting these steps, contact the technical support team for the camera's manufacturer.

Consider This: What are some reasons why you might use a webcam or integrated DV camera on your computer or mobile device?

☀️ CONSIDER THIS

What is the purpose of a videoconference versus a video call?

Where video calls usually are for personal use, videoconferences typically are for business use. A **videoconference** is a meeting between two or more geographically separated people who use a network or the Internet to transmit audio and video data (Figure 7-15). To participate in a videoconference using a computer, you need videoconferencing software or access to a videoconferencing web app, along with a microphone, speakers, and a video camera attached to or built into a computer. As you speak, members of the meeting hear your voice on their speakers. Any image in front of the video camera, such as a person's face, appears in a window on each participant's screen.

Discover More: Visit this chapter's free resources to learn more about videoconference software.



Figure 7-15 To save on travel expenses, many large businesses use videoconferencing.

Idprod / Fotolia

You can configure some webcams to display the images they capture remotely on a webpage, or via an app on a mobile device. This use of a webcam attracts website visitors by showing images that change regularly. Home or small business users might use webcams to show a work in progress, weather and traffic information, or employees at work; they also might use it as a security system. Some websites have live webcams that display still pictures and update the displayed image at a specified time or time intervals, such as every 15 seconds. A *streaming cam* has the illusion of moving images because it sends a continual stream of still images. Read Secure IT 7-2 to learn about security issues related to using webcams.

🔒 SECURE IT 7-2

📄 Digital Video Security

Sales of home security systems are on the rise due to their low costs and easy setup. These systems use cameras and sensors to monitor activity, and most send a message via mobile phone to alert a user of movement and entrance or exit into the dwelling and send the webcam's live feed of the scene.

This use of webcams serves a practical use in a private setting. Similarly, webcams in public areas, such as shopping malls, parking lots, and school cafeterias, help with surveillance measures and record everyday activity.

Webcam use, however, is criticized when the live feeds are used in a manner without the recorded parties' consent. Ethics and Issues 3-1 in Chapter 3 discusses the appropriate punishment for webcam spying, citing examples of criminals who hacked into home computers and streamed live video feeds, school administrators who took 66,000

pictures and screen captures of students using school-distributed laptops at home, and rent-to-own stores that rented laptops with spyware that captured photos of customers in their homes. Digital video recorders also are hidden in products resembling remote car keys, wall and desk clocks, sunglasses, smoke detectors, and electrical boxes.

If you have a webcam, follow these measures to prevent its unauthorized use:

- **Unplug the webcam.** This obvious suggestion offers the most secure solution. If the webcam is not connected to the computer, it cannot reveal what is occurring in front of the lens.
- **Cover the lens and plug the microphone.** Place a piece of black electrical tape over the lens, and insert a dummy plug in the microphone port. This solution is ideal for tablets and laptops equipped with cameras.

- **Register the hardware.** Hardware manufacturers continually update their firmware to fix issues. If you register your product, the companies can notify you of known security holes and offer updates to download.
- **Use a strong password.** When connecting a webcam to a network, you may need to configure the device for features such as sending an email or text message when motion is detected. If you are prompted to create a password, be certain it can resist hackers and malicious software. Read Secure IT 1-3 in Chapter 1 for tips about creating strong passwords.

☀️ **Consider This:** If you have a webcam, what actions will you take to protect your privacy? Should you be warned of webcam use when you are in a public area? If so, how can these warnings be given? Would you consider buying a digital video recorder for surveillance purposes?

Scanners and Reading Devices

Some input devices save users time by capturing data directly from a *source document*, which is the original form of the data. Examples of source documents include time cards, order forms, invoices, paychecks, advertisements, brochures, photos, inventory tags, or any other document that contains data to be processed.

Devices that can capture data directly from a source document include optical scanners, optical readers, bar code readers, RFID (radio frequency identification) readers, magnetic stripe card readers, and MICR (magnetic-ink character recognition) readers.

Optical Scanners

An optical scanner, usually called a **scanner**, is a light-sensing input device that reads printed text and graphics and then translates the results into a form the computer can process. A flatbed scanner works in a manner similar to a copy machine except it creates a file of the document in memory instead of a paper copy (Figure 7-16). Once you scan a picture or document, you can display the scanned object on the screen, modify its appearance, store it on a storage medium, print it, attach it to an email message, include it in another document, or post it on a website or photo community for everyone to see.

The quality of a scanner is measured by its resolution, that is, the number of bits it stores in a pixel and the number of pixels per inch. The higher each number, the better the quality, but the more expensive the scanner.

Many scanners include *OCR* (optical character recognition) *software*, which can read and convert text documents into electronic files. OCR software converts a scanned image into a text file that can be edited, for example, with a word processing application.



CONSIDER THIS

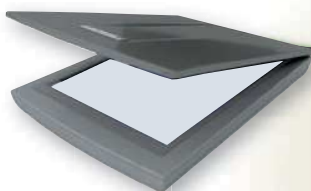
How can you improve the quality of scanned documents?

Place a blank sheet of paper behind translucent papers, newspapers, and other transparent types of paper. If the original is crooked, draw a line on the back at the bottom of the image. Use that mark to align the original on the scanner. Use photo editing software to fix imperfections in images.

How a Flatbed Scanner Works

Step 1

Place the document to be scanned face down on the glass window. Using buttons on the scanner or the scanner program, start the scanning process.



Step 2

The scanner converts the document content to digital information, which is transmitted through the cable to the computer's memory and saved on the computer's hard drive.

Step 3

Once in the computer, users can display the image, print it, send it in an email message, include it in a document, or place it on a webpage.



Figure 7-16 This figure shows how a flatbed scanner works.

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Optical Readers

An optical reader is a device that uses a light source to read characters, marks, and codes and then converts them into digital data that a computer can process. Two technologies used by optical readers are optical character recognition (OCR) and optical mark recognition (OMR).

- Most **OCR devices** include a small optical scanner for reading characters and sophisticated software to analyze what is read. OCR devices range from large machines that can read thousands of documents per minute to handheld wands that read one document at a time. OCR devices read printed characters in a special font.
- **OMR devices** read hand-drawn marks, such as small circles or rectangles. A person places these marks on a form, such as a test, survey, or questionnaire answer sheet (shown in Figure 7-1 at the beginning of this chapter).

Bar Code Readers

A **bar code reader**, also called a *bar code scanner*, is an optical reader that uses laser beams to read bar codes (Figure 7-17). A **bar code** is an identification code that consists of either a set of vertical lines and spaces of different widths or a two-dimensional pattern of dots, squares, and other images. The bar code represents data that identifies the manufacturer and the item.

Manufacturers print a bar code either on a product's package or on a label that is affixed to a product, such as groceries, books, clothing, vehicles, mail, and packages. Each industry uses its own type of bar code. The United States Postal Service (USPS) uses a POSTNET bar code. Retail and grocery stores use the *UPC (Universal Product Code)* bar code.

A **QR code** (quick response code) is known as a 2-D bar code because it stores information in both a vertical and horizontal direction (Figure 7-18). The information it stores can correspond to a web address or other content, such as contacts or phone numbers. QR codes can be read with a QR bar code reader or a QR code reader app on a smartphone or other mobile device. All types of material, from posters to textbooks to merchandise, include QR codes that consumers scan to obtain additional information, which may be in the form of a website or may display text for the user to read. For information about safely scanning QR codes, read Secure IT 7-3.

Discover More: Visit this chapter's free resources to learn more about QR code reader apps.



Figure 7-17 A bar code reader uses laser beams to read bar codes on products such as clothing, shown here.

© iStockPhoto / klaptoman



Figure 7-18 This customer pays her bills by scanning an on-screen QR code.

© iStockPhoto / gpointstudio



Technology Innovators


Discover More: Visit this chapter's free resources to learn about Masahiro Hara and Denso Wave, QR code inventors.



Internet Research

What are current uses of QR codes?

Search for: qr code uses

 **SECURE IT 7-3**
 **Safely Scanning QR Codes**

QR codes have come a long way since their first use, which was in tracking parts used to manufacture Japanese cars. Now they are used to market, educate, and entertain. Every industry has found some benefit of using innovative and creative QR technology to benefit workers and the public. They have become a necessary method of providing additional information about exhibits, downloading apps, displaying videos, advertising items, and performing thousands of other functions.

As with most computer applications, however, users must be cautious by scrutinizing the QR codes they see, in an attempt to thwart malicious attacks. Follow these guidelines to use QR codes safely:

- **Scan trustworthy sources.** In general, QR codes in books, magazines, and


newspapers are safe. Posters on the street or on leaflets handed out on street corners, however, may not be as secure. Verify the source of the codes before scanning them.

- **Verify the web address.** Most QR code reader apps show the address of the website that will be displayed. If you do not recognize the domain name or the web address looks suspicious, do not grant permission.
- **Choose a reputable QR scanner.** Visit trustworthy Android marketplaces and the iTunes Store for safe QR apps. Look for safety features that will check the authenticity of destination websites, issue warnings for malicious QR codes, display a preview of each code, and block unsafe websites.

- **Do not supply personal information.**

If the QR code directs you to a website displaying a form, do not enter personal or financial data unless you are certain that the website is safe, secure, and authentic.

- **Check for tampering.** Verify the QR code is original. Unscrupulous people may place a fraudulent sticker over the printed code.

 **Consider This:** Where have you seen QR codes? Have you scanned any? If so, what information have you obtained? Have you followed any of the security precautions listed above? If not, which will you now follow?

RFID Readers

RFID (radio frequency identification) is a technology that uses radio signals to communicate with a tag placed in or attached to an object, an animal, or a person. RFID

tags, which contain a memory chip and an antenna, are available in many shapes and sizes. An **RFID reader** reads information on the tag via radio waves. RFID readers can be handheld devices or mounted in a stationary object, such as a doorway.

Many retailers see RFID as an alternative to bar code identification because it does not require direct contact or line-of-site transmission. Each product in a store would contain a tag that identifies the product. As consumers remove products from the store shelves and walk through a checkout area, an RFID reader reads the tag(s) and communicates with a computer that calculates the amount due and updates inventory.

Other uses of RFID include tracking times of runners in a marathon; tracking location of people, airline baggage, and misplaced or stolen goods; checking lift tickets of skiers; managing inventory; gauging temperature and pressure of tires on a vehicle; checking out library books; providing access to rooms or buildings (Figure 7-19); managing purchases; and tracking payment as vehicles pass through booths on tollway systems.



Figure 7-19 This electronic key system locks and unlocks doors using RFID technology.

© iStockPhoto / iggy1965

Magstripe Readers

A **magstripe reader**, short for *magnetic stripe card reader*, reads the magnetic stripe on the back of credit cards, entertainment cards, bank cards, identification cards, and other similar cards (Figure 7-20). The stripe contains information identifying you and the card issuer. Some information stored in the stripe may include your name, account number, the card's expiration date, and a country code.



Figure 7-20 A magstripe reader reads information encoded on the stripe on the back of a credit card.

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Most magstripe readers are separate devices that communicate with a POS (point-of-sale) terminal, such as those in retail stores. Home or small business users, however, may attach a small plastic magstripe reader to a smartphone or tablet so that they can accept payments using a mobile app. When a credit card is swiped through a magstripe reader, it reads the information stored on the magnetic stripe on the card. Read Secure IT 7-4 for tips about how to protect credit cards from scanning devices.

Internet Research

What types of mobile magstripe readers are available?

Search for: mobile magstripe readers

SECURE IT 7-4

Protecting Credit Cards from Scanning Devices

One-third of the 775 million credit and debit cards issued in the United States are likely targets for high-tech thieves who can steal the account information quickly and silently. RFID technology embedded in these cards transmits signals with the coded account information to scanners, which thieves place in their coat pockets, purses, and other nonmetallic containers. Some signals have a range as far as 30 feet, so that the electronic pickpockets simply walk among crowds in search of obtaining these radio waves.

The RFID technology embedded in the credit cards is approximately the size of a postage stamp. It consists of a coil of wire connected to an electronic circuit that generates a pattern of electrical pulses with coded account information

unique to a specific card. An antenna transmits these radio waves to a scanner.

The radio waves do not penetrate metal or water easily. You, consequently, can protect these cards and documents by wrapping them in aluminum foil or placing them near water bottles. Security experts also recommend stacking several credit cards in an attempt to scramble the signals. Place the cards in your wallet with the magnetic strip facing inside. RFID-blocking wallets also are manufactured to prevent scanners from obtaining the emitted signals.

To determine if your credit or debit card has this RFID technology, look for the words, PayPass, PayWave, Blink, or a radio wave symbol, as shown in the figure. If you do not see this information, call customer service or search the company's website. This technology

also is found in passports, driver's licenses, hotel room keys, and university and employee identification cards, so you may need to protect these documents and cards from electronic pickpockets, too.



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Consider This: Are any of your credit or debit cards or personal documents embedded with RFID technology? If so, what precautions will you take to block the signals from scanners?

CONSIDER THIS**Why are some magnetic stripes not readable by a magstripe reader?**

If the magstripe reader rejects the card, it is possible that the magnetic stripe is scratched, dirty, or erased. Exposure to a magnet or magnetic field can erase the contents of a card's magnetic stripe.

CONSIDER THIS**What is a smart card?**

A smart card stores data on an integrated circuit embedded in a card, such as a credit card. Chapter 8 discusses smart cards in more depth.



Figure 7-21 The MICR characters preprinted on the check represent the bank routing number, customer account number, and check number. The amount of the check in the lower-right corner is added after the check is cashed.

© Cengage Learning



Figure 7-22 An employee in a warehouse uses this data collection device to scan items, which wirelessly transmits information about the scanned item to the store's inventory system.

© endostock / Fotolia

MICR Readers

MICR (magnetic-ink character recognition) *devices* read text printed with magnetized ink. An MICR reader converts MICR characters into a form the computer can process. The banking industry almost exclusively uses MICR for check processing. Each check in your checkbook has precoded MICR characters beginning at the lower-left edge (Figure 7-21).

When a bank receives a check for payment, it uses an MICR inscriber to print the amount of the check in MICR characters in the lower-right corner. Each check is inserted in an MICR reader, which sends the check information — including the amount of the check — to a computer for processing.

Data Collection Devices

Instead of reading or scanning data from a source document, a *data collection device* obtains data directly at the location where the transaction or event takes place. For example, employees use bar code readers, handheld computers, or other mobile devices to collect data wirelessly (Figure 7-22). These types of data collection devices are used in restaurants, grocery stores, factories, warehouses, the outdoors, or other locations where heat, humidity, and cleanliness are not easy to control. For example, factories and retail stores use data collection devices to take inventory and order products.

Data collection devices and many mobile computers and devices have the capability of wirelessly transmitting data over a network or the Internet. Increasingly more users today send data wirelessly to central office computers using these devices.

NOW YOU SHOULD KNOW

Be sure you understand the material presented in the sections titled Motion, Voice, and Video Input, and Scanners and Reading Devices, as it relates to the chapter objectives.

Now you should know...

- Which type of motion, voice, and video input are best suited to your needs (Objective 5)
- Why you would use optical scanners and readers, bar code readers, RFID readers, magstripe readers, MICR readers, and data collection devices (Objective 6)

Discover More: Visit this chapter's premium content for practice quiz opportunities.

What Is Output?

Output is data that has been processed into a useful form. Recall that computers process data (input) into information (output). The form of output varies, depending on the hardware and software being used and the requirements of the user. Users view or watch output on a screen, print it, or hear it through speakers, headphones, or earbuds. While working with a computer or mobile device, a user encounters four basic types of output: text, graphics, audio, and video (Figure 7-23). Very often, a single form of output, such as a webpage, includes more than one of these types of output.



Figure 7-23 Four types of output are text, graphics, audio, and video.

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Technology Innovator

Discover More: Visit this chapter's free resources to learn about Ursula Burns, who has served as chair and CEO of Xerox.

- **Text:** Examples of output that primarily contain text are text messages, Internet messages, memos, letters, press releases, reports, classified advertisements, envelopes, and mailing labels. On the web, users read blogs, news and magazine articles, books, television show transcripts, stock quotes, speeches, and lectures.
- **Graphics:** Many forms of output include graphics to enhance visual appeal and convey information. Business letters have logos. Reports include charts. Newsletters use drawings, clip art, and photos. Users print high-quality photos taken with a digital camera. Many websites use animation.
- **Audio:** Users download their favorite songs and listen to the music. Software, such as games, encyclopedias, and simulations, often include musical accompaniments and audio clips, such as narrations and speeches. On the web, users listen to radio broadcasts, audio clips, podcasts, sporting events, news, music, and concerts. They also use VoIP.
- **Video:** As with audio, software and websites often include video clips and video blogs. Users watch news reports, movies, sporting events, weather conditions, and live performances on a computer or mobile device. They attach a video camera to a computer or mobile device to watch video or programs.



CONSIDER THIS

Are storage devices categorized as input or output devices?

When storage devices write on storage media, they are creating output. Similarly, when storage devices read from storage media, they function as a source of input. Nevertheless, they are categorized as storage devices, not as input or output devices.

Common methods of output include displays, printers, speakers, headphones and earbuds, data projectors, interactive whiteboards, and force-feedback game controllers and tactile output. The following sections discuss each of these output devices.

Displays

A *display device*, or simply **display**, is an output device that visually conveys text, graphics, and video information. Sometimes called *soft copy*, information on a display exists electronically and appears

for a temporary period. Displays consist of a screen and the components that produce the information on the screen. Most current displays are a type of *flat-panel display*, which means they have a shallow depth and a flat screen. Figure 7-24 shows displays for a variety of computers and mobile devices.

Desktops often use a monitor as their display. A **monitor** is a display that is packaged as a separate peripheral device. Some monitors have a tilt-and-swivel base, which allows you to adjust the angle of the screen to minimize neck strain and reduce glare from overhead lighting. With some, you also can rotate the screen. Adjustable monitor stands allow you to



Figure 7-24 A variety of displays.

© cobalt88 / Shutterstock.com; © Pawel Gaul / Photos.com; © Maxx-Studio / Shutterstock.com; © iStockphoto / BarisSimsek; © bloomua / Fotolia

adjust the height of the monitor. Monitor controls enable you to adjust the brightness, contrast, positioning, height, and width of images. Some have touch screens, integrated speakers, and/or a built-in webcam. Today's monitors have a small footprint; that is, they do not take up much desk space. For additional space savings, some monitors are wall mountable.

Most mobile computers and devices integrate the display and other components into the case. Size of these displays varies depending on the mobile computer or device. Some mobile computers and many mobile devices have touch screens. Traditional laptops have a display that attaches with a hinge to the case. (Read How To 7-2 to learn how to connect a laptop to an external display.) Tablets are available with two types of displays: one that attaches with a hinge and one built into the top of the case. Some smartphone and digital camera displays also attach with a hinge to the device. On other smartphones and most portable media players, digital cameras, and handheld game consoles, the display is built into the case. Newer vehicles integrate a display in the dashboard, enabling drivers to control audio, video, navigation, temperature, and other settings.

Discover More: Visit this chapter's free resources to learn more about monitor and display sizes and manufacturers.



Measuring Displays

You measure the screen on a monitor, laptop, tablet, smartphone, or other mobile device the same way you measure a television; that is, you measure diagonally from one corner to the other.

HOW TO 7-2

Connect a Laptop to an External Display

When you are using a laptop, you may need to connect it to an external display for a variety of reasons. If you are giving a presentation, connecting a laptop to a projector or television will allow attendees to view presentation slides or other media content. If you use your laptop at a desk, you might want to connect it to a larger display so that you can more easily see the content without straining your eyes, or you may want to work with two open programs simultaneously with one displaying on the laptop screen and the other on the external display. The following steps describe how to connect a laptop to an external display.

1. Verify that your laptop is compatible with the external display.
2. Make sure that you have a cable that can connect from a port on your laptop to a port or cable connected to the external display. If not, you may need to purchase an adapter.
3. Verify that your laptop supports a screen resolution that the external display also supports.

4. Use the cable to connect your laptop's video port to the video input port for the external display.
5. External displays often have multiple video input ports; make sure the external display is configured to display the content from the port to which your laptop is connected.
6. If necessary, configure the laptop to display content on the external display. This often can be done by pressing a

key on the keyboard or accessing the operating system's display settings.

7. If necessary, change the screen resolution on the laptop so that the contents display properly on the external display.

Consider This: What are some other reasons why you might want to connect your laptop to an external display?



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Display Technologies

Many desktop monitors, along with the screens on mobile computers and devices, use some type of LCD technology. A *liquid crystal display (LCD)* sandwiches a liquid compound between two sheets of material that presents sharp, flicker-free images on a screen when illuminated. The light source, called the *backlight*, often uses either CCFL (cold cathode fluorescent lamp) or LED (light-emitting diode) technology.



Internet Research

What is in-plane switching (IPS)?

Search for: ips display

A display that uses LED for the backlight often is called an *LED display* or an LED LCD display. LED displays consume less power, last longer, and are thinner, lighter, and brighter than a display that uses CCFL technology, but they also may be more expensive. Screens in laptops and mobile devices often use LED backlight technology.

LCD displays typically produce color using *active-matrix*, or *TFT* (thin-film transistor), technology, which uses a separate transistor to apply charges to each liquid crystal cell and, thus, displays high-quality color that is viewable from all angles. Several types of active matrix displays, or panels, are available, with some providing higher quality than others.

Instead of LCD or traditional LED, some displays use OLED technology. *OLED* (organic LED) uses organic molecules that are self-illuminating and, thus, do not require a backlight. OLED displays consume less power and produce an even brighter, easier-to-read display than LCD or LED displays, but they can have a shorter life span. OLEDs also can be fabricated on thin, flexible surfaces.

Many mobile computers and devices use either AMOLED or Retina Display technology. An *AMOLED* (active-matrix OLED) screen uses both active-matrix and OLED technologies, combining the benefits of high-quality viewing from all angles with lower power consumption. Variations of AMOLED provide different levels of viewing quality. *Retina Display*, developed by Apple, produces vibrant colors and supports viewing from all angles because the LCD technology is built into the screen instead of behind it and contains more pixels per inch of display. Recall that a *pixel* (short for picture element) is a single point in an electronic image.

Discover More: Visit this chapter's free resources to learn more about active-matrix displays.

Display Quality

The quality of a display depends primarily on its resolution, response time, brightness, dot pitch, and contrast ratio.

- **Resolution** is the number of horizontal and vertical pixels in a display. For example, a monitor or screen that has a 1600×900 resolution displays up to 1600 pixels per horizontal row and 900 pixels per vertical row, for a total of 1,440,000 pixels to create a screen image. A higher resolution uses a greater number of pixels and, thus, provides a smoother, sharper, and clearer image. As the resolution increases, however, some items on the screen appear smaller.

Displays are optimized for a specific resolution, called the *native resolution*. Although you can change the resolution to any setting, for best results, use the monitor or screen's native resolution setting.

- *Response time* of a display refers to the time in milliseconds (ms) that it takes to turn a pixel on or off. Response times of displays range from 2 to 16 ms. The lower the number, the faster the response time.
- Brightness of a display is measured in nits. A *nit* is a unit of visible light intensity equal to one candela (formerly called candlepower) per square meter. The *candela* is the standard unit of luminous intensity. Displays today range from 250 to 550 nits. The higher the nits, the brighter the images.
- *Dot pitch*, sometimes called *pixel pitch*, is the distance in millimeters between pixels on a display. Text created with a smaller dot pitch is easier to read. Advertisements normally specify a display's dot pitch or pixel pitch. Average dot pitch on a display should be .30 mm or lower. The lower the number, the sharper the image.
- *Contrast ratio* describes the difference in light intensity between the brightest white and darkest black that can be produced on a display. Contrast ratios today range from 500:1 to 2000:1. Higher contrast ratios represent colors better.

Graphics Chips, Ports, and Flat-Panel Monitors A cable on a monitor plugs in a port on the computer, which enables communications from a graphics chip. This chip, called the *graphics processing unit* (GPU), controls the manipulation and display of graphics on a display device. The GPU either is integrated on the motherboard or resides on a video card in a slot on the motherboard.

Today's monitors use a digital signal to produce a picture. To display the highest quality images, the monitor should plug in a DVI port, an HDMI port, or a DisplayPort.

- A *DVI (Digital Video Interface) port* enables digital signals to transmit directly to a monitor.
- An *HDMI (High-Definition Media Interface) port* combines DVI with high-definition (HD) television, audio, and video. Some ultrathin laptops have mini-HDMI ports that require the use of an adapter (or dongle) when connecting to a standard-size HDMI display.
- A *DisplayPort* is an alternative to DVI that also supports high-definition audio and video.

Over the years, several video standards have been developed to define the resolution, aspect ratio, number of colors, and other display properties. The *aspect ratio* defines a display's width relative to its height. A 2:1 aspect ratio, for example, means the display is twice as wide as it is tall. The aspect ratio for a *widescreen monitor* is 16:9 or 16:10. Some displays support multiple video standards. For a display to show images as defined by a video standard, both the display and GPU must support the same video standard.

Discover More: Visit this chapter's free resources to learn more about video standards.

DTVs and Smart TVs

Home users sometimes use a digital television (DTV) as a display. Gamers also use a television as their output device. They plug one end of a cable in the game console and the other end in the video port on the television.

HDTV (high-definition television) is the most advanced form of digital television, working with digital broadcast signals, transmitting digital sound, supporting wide screens, and providing high resolutions. A *Smart TV* is an Internet-enabled HDTV from which you can browse the web, stream video from online media services, listen to Internet radio, communicate with others on online social media, play online games, and more — all while watching a television show (Figure 7-25). Using a SmartTV, you can stream content from the TV to other Internet-enabled devices, such as a tablet or smartphone, and use cloud storage services to share content. Read How To 7-3 to learn how to show media on a Smart TV from your computer or device.



Figure 7-25 Smart TVs enable you to connect to the Internet and/or watch television shows.
Courtesy of LG Electronics USA Inc.

HOW TO 7-3

Show Media on a Smart TV from Your Computer or Device

Smart TVs can connect to the network in your home using a wired or wireless connection. Compatible computers and devices connected to the same network can display content on the Smart TV. For example if you connect your smartphone to the same network as the Smart TV, you can display pictures from the phone on the Smart TV. The following steps describe how to show media on a Smart TV from a computer or device.

1. Verify that your computer or device is capable of displaying content on the Smart TV.
2. Make sure that the computer or device is connected to the same network as the Smart TV.
3. Navigate to the settings on the computer or device and specify that you want to mirror the display on the Smart TV.
4. Navigate to the settings on the Smart TV, if necessary, and enable the setting that allows content from computers and devices to be displayed.
5. Continue to use the computer or device when the video from your computer or device is displayed on the Smart TV.
6. When you no longer wish to display the content from your computer or device on

the Smart TV, change the setting on your computer or mobile device to disable this feature.

Consider This: What type of media might you display on your Smart TV? Why?



© iStockPhoto / chargen8

DTVs often use LCD, LED, or plasma technology. A *plasma display* uses gas plasma technology, which sandwiches a layer of gas between two glass plates. When voltage is applied, the gas releases ultraviolet (UV) light. This UV light causes the pixels on the screen to glow and form an image. Read Ethics & Issues 7-3 to consider the effects of radiation from monitors and other devices.

ETHICS & ISSUES 7-3



Should We Be Concerned with Hardware Radiation?

When you work on a computer or talk on a mobile phone, could you be at risk from harmful radiation? Every electronic device emits some level of radiation. While the amounts for computers and mobile devices may not be harmful in low doses, some critics argue that constant exposure, such as sitting in an office all day or wearing a Bluetooth headset for several hours at a time, can cause levels of radiation that, over time, may cause cancer or other health concerns. In addition to the computer itself, peripheral devices, such as printers, along with the wireless or cordless methods to connect the devices, emit radiation.

Research is inconclusive about safe levels and long-term risks. Most agree that it is not the level from any one device, but rather the cumulative effect from long-term exposure (several hours a day over many years) to multiple devices simultaneously that causes harm.

You can protect yourself and minimize your risks. Replace older equipment, such as CRT (cathode-ray tube) monitors, with devices such as LCD monitors, which meet current emission standards. Sit back from your monitor as far as possible, and place a barrier between your computer and your lap. Move other electronic sources, such as hard drives and printers, as far away as possible. Minimize your wireless connections, such

as a wireless keyboard or a wireless mouse. Remove your Bluetooth headset when not in use, and frequently switch the headset from one ear to the other. Turn off devices when not in use. Recycle or donate older, unused devices to eliminate any radiation exposure from older devices, even when they are not in use.

Consider This: Do you consider computers and mobile devices to be harmful to your health? Why or why not? Would you change your electronic device usage, change your habits, or rearrange your computer work area to minimize your risk? Why or why not? What modifications can you make?

Internet Research

What are popular television streaming media services?

Search for: television streaming media



CONSIDER THIS

Can you view the output from your display remotely?

With a television streaming media device, you can view and control a home DVR or TV from a remote computer or mobile device.



NOW YOU SHOULD KNOW

Be sure you understand the material presented in the sections titled What is Output? and Displays, as it relates to the chapter objectives.

Now you should know...

- What types of output you may encounter (Objective 7)
- What to consider when purchasing computers and devices with various displays (Objective 8)

Discover More: Visit this chapter's premium content for practice quiz opportunities.

Printers

A **printer** is an output device that produces text and graphics on a physical medium, such as paper. Printed information (hard copy) exists physically and is a more permanent form of output than that presented on a display (soft copy).

A hard copy, also called a *printout*, is either in portrait or landscape orientation. A printout in *portrait orientation* is taller than it is wide, with information printed across the shorter width of the paper. A printout in *landscape orientation* is wider than it is tall, with information printed across the widest part of the paper. Letters, reports, and books typically use portrait orientation. Spreadsheets, slide shows, and graphics often use landscape orientation.

CONSIDER THIS

Can you print documents and photos from a mobile computer and device without physically connecting to the printer with a cable?

Yes. Many printers contain memory card slots, so that you can remove the memory card from a camera, insert it in the printer, and print photos directly from the card. You also can connect a printer to a wireless network so that devices with a Wi-Fi connection can print wirelessly. With *Bluetooth printing*, a computer or other device transmits output to a printer via radio waves. The computer or other device and the printer do not have to be aligned with each other; rather, they need to be within an approximate 30-foot range.



Technology Innovator
Discover More: Visit this chapter's free resources to learn about HP, a multinational technology company.

To meet the range of printing needs from home users to enterprise users, many different types and styles of printers exist with varying speeds, capabilities, and printing methods. Figure 7-26 presents a list of questions to help you determine the printer best suited to your needs.

Nonimpact Printers

A **nonimpact printer** forms characters and graphics on a piece of paper without actually contacting the paper. Some spray ink, while others use heat or pressure to create images.

Commonly used nonimpact printers are ink-jet printers, photo printers, laser printers, all-in-one printers, thermal printers, mobile printers, label printers, plotters, and large-format printers.

Ink-Jet Printers

An **ink-jet printer** is a type of nonimpact printer that forms characters and graphics by spraying tiny drops of liquid ink onto a piece of paper. Ink-jet printers have become a popular type of color printer for use in the home.

Ink-jet printers produce text and graphics in both black-and-white and color on a variety of paper types and sizes (Figure 7-27). These printers normally use individual sheets of paper stored in one or two removable or stationary trays. Most ink-jet printers can print lab-quality photos. Ink-jet printers also print on other materials, such as envelopes, labels, index cards, greeting card paper (card stock), transparencies, and iron-on T-shirt transfers. Many ink-jet printers include software for creating greeting cards, banners, business cards, and letterhead.

The speed of an ink-jet printer is measured by the number of pages per minute (ppm) it can print. Graphics and colors print at a slower rate than text.

Discover More: Visit this chapter's free resources to learn more about ink-jet printers.

1. What is my budget?
2. How fast must my printer print?
3. Do I need a color printer?
4. What is the cost per page for printing?
5. Do I need multiple copies of documents?
6. Will I print graphics?
7. Do I want to print photos?
8. Do I want to print directly from a memory card?
9. What types of paper does the printer use?
10. What sizes of paper does the printer accept?
11. Do I want to print on both sides of the paper?
12. How much paper can the printer tray hold?
13. Will the printer work with my computer and software?
14. How much do supplies such as ink, toner, and paper cost?
15. Can the printer print on envelopes?
16. How many envelopes can the printer print at a time?
17. How much do I print now, and how much will I be printing in a year or two?
18. Will the printer be connected to a network?
19. Do I want wireless printing capability?

Figure 7-26 Questions to consider before purchasing a printer.
 © Cengage Learning



Figure 7-27 Ink-jet printers are a popular type of color printer used at home and in the office.

© iStockphoto / Greg Nicholas; JurgaR / iStockphoto; Courtesy of Xerox Corporation; JurgaR / iStockphoto; Courtesy of Xerox Corporation

 **CONSIDER THIS**
How does resolution affect print quality?

As with many other input and output devices, one factor that determines the quality of an ink-jet printer is its resolution. Printer resolution is measured by the number of *dots per inch (dpi)* a printer can print. With an ink-jet printer, a dot is a drop of ink. A higher dpi means the print quality is higher because the drops of ink are smaller and more drops fit in an area.

The difference in quality becomes noticeable when the size of the printed image increases. That is, a wallet-sized image printed at 1200 dpi may look similar in quality to one printed at 2400 dpi. When you increase the size of the image, to 8×10 for example, the printout of the 1200 dpi resolution may look grainier than the one printed using a 2400 dpi resolution.

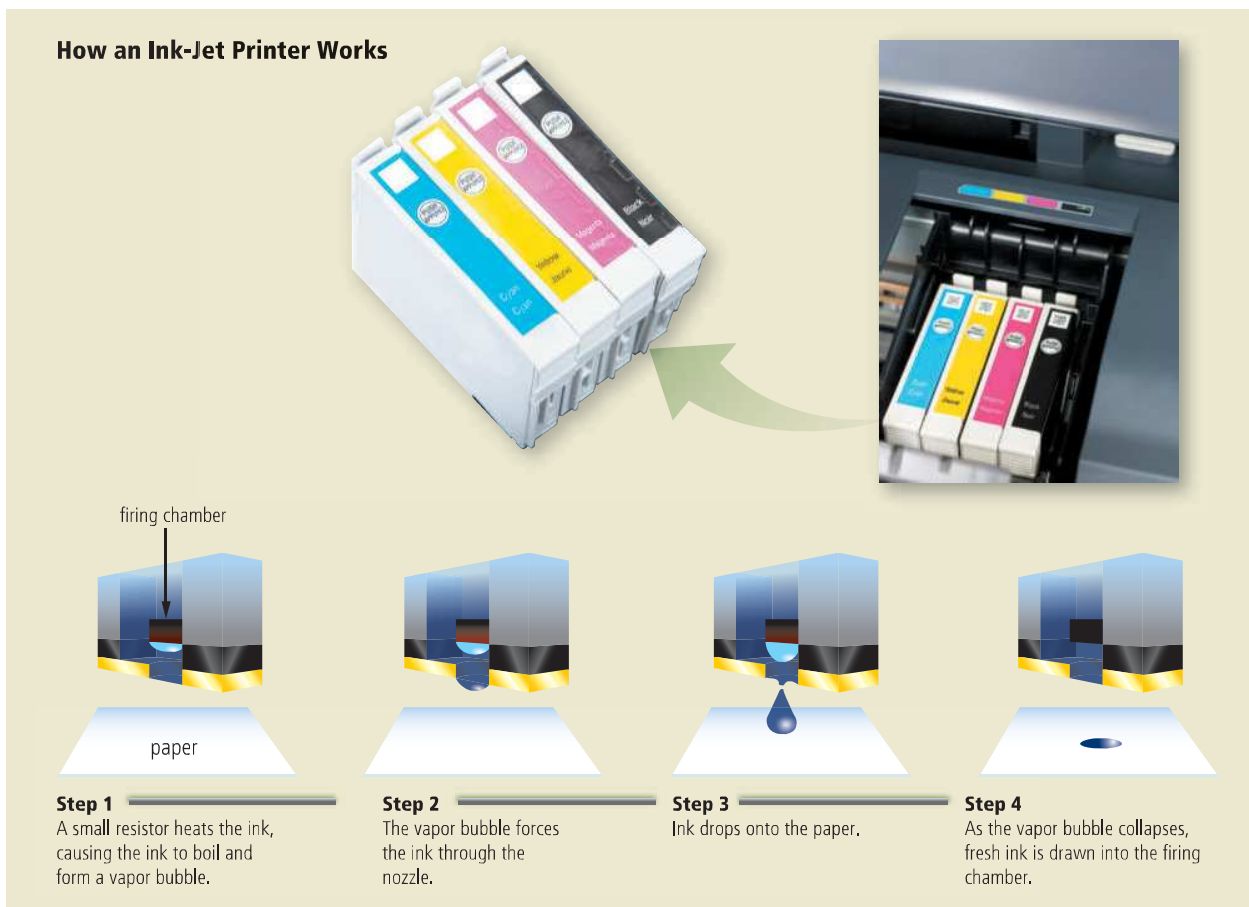
Ink Cartridges The printhead mechanism in an ink-jet printer contains ink-filled cartridges. Each cartridge has fifty to several hundred small ink holes, or nozzles. The steps in Figure 7-28 illustrate how a drop of ink appears on a page. The ink propels through any combination of the nozzles to form a character or image on the paper.

When the cartridge runs out of ink, you simply replace the cartridge. Most ink-jet printers use two or more ink cartridges, one containing black ink and the other(s) containing colors. Some color cartridges contain a variety of ink colors; others contain only a single color. Consider the number of ink cartridges a printer requires, along with the cost of the cartridges, when purchasing a printer. To reduce the expense of purchasing cartridges, some users opt to purchase refilled cartridges or have empty cartridges refilled by a third-party vendor.

 **Internet Research**

How much do ink cartridges cost?

Search for: ink cartridge cost comparison



 **Figure 7-28** This figure shows how an ink-jet printer works.

© BoyanDimitrov / Shutterstock.com; © Almaamor / Dreamstime.com; © Cengage Learning

Photo Printers

A **photo printer** is a color printer that produces lab-quality photos (Figure 7-29). Some photo printers print just one or two sizes of photos, for example, 3 × 5 inches and 4 × 6 inches. Others print up to 8 × 10 or even larger. Some even print panoramic photos. Generally, the more sizes the printer prints, the more expensive the printer.

Many photo printers use ink-jet technology. With models that can print letter-sized documents, users connect the photo printer to their computer and use it for all their printing needs. For a few hundred dollars, this type of photo printer is ideal for the home or small business user.

Most photo printers are PictBridge enabled, so that you can print photos without a computer. *PictBridge* is a standard technology that allows you to print photos directly from a digital camera by connecting a cable from the digital camera to a USB

port on the printer. Photo printers also usually have a built-in card slot(s) so that the printer can print digital photos directly from a memory card. Read How To 7-4 for instructions about printing from a smartphone or tablet.

Discover More: Visit this chapter's free resources to learn more about photo printers.



Figure 7-29 A photo printer.

© iStockphoto / Tamás Ambrits

HOW TO 7-4

Print from a Smartphone or Tablet

As smartphones and tablets become more widely used and packed with features, you may need to print items stored on these devices. For example, you may capture a great photo while spending time with your family and want to print the photo to place on your desk, or you may take notes on your tablet and want to print a hard copy. You have several options available to print from a smartphone or tablet. The method you use will depend primarily on the type of mobile device and printer you are using, and the printer must support printing from a mobile device. The following steps describe how to print from a smartphone or tablet:

1. Verify your mobile device or tablet is connected to the same network as the printer.
2. If necessary, download and install an app on your device or tablet to enable you to print. The printer's documentation will inform you if you need an app and, if so, where to obtain it.

3. When you are viewing the item that you want to print on your smartphone or tablet, select the option to print on your printer and then retrieve the printout.

In addition to using an app or built-in features on your mobile device or computer to print, you may be able to configure your printer so that you can attach files and send them to a specified email address. The following steps describe how to use this feature on supported printers:

1. Access your printer's settings and make sure the printer is connected to your network.
2. Configure the option to set up an email address for receiving print jobs and write down that email address.
3. On your computer or mobile device, send the file you want to print as an attachment to an email message addressed to the email address determined in Step 2.
4. When the printer receives the email message with the file attachment, it will print the file.

If your mobile device or printer does not support wireless printing, you also can print

by transferring the file from your smartphone or tablet to your laptop, desktop, or printer. The following steps describe how to print from a smartphone or tablet when wireless printing is not supported:

1. Remove the memory card from your smartphone or tablet and insert it into your laptop, desktop, or printer. *Note:* If your smartphone or tablet does not have a removable memory card, you can connect the smartphone or tablet to a desktop, laptop, or printer using the USB cable included with your device.
2. On the laptop, desktop, or printer, navigate to and select the file you want to print, and then select the option to print the file.
3. When the printer stops, safely remove the memory card from the laptop, desktop, or printer and insert it in your smartphone or tablet.


 **Consider This:** What are some other reasons why you might want to print from a smartphone or tablet?



Figure 7-30 A laser printer.
Courtesy of Xerox Corporation

Internet Research
How much does toner for a laser printer cost?

Search for: laser printer toner cost comparison

a laser printer creates images using a laser beam and powdered ink, called *toner*. The laser beam produces an image on a drum inside the printer. The light of the laser alters the electrical charge on the drum wherever it hits. When this occurs, the toner sticks to the drum and then transfers to the paper through a combination of pressure and heat (Figure 7-31). When the toner runs out, you replace the toner cartridge.

Laser Printers

A **laser printer** is a high-speed, high-quality nonimpact printer (Figure 7-30). Laser printers are available in both black-and-white and color models. A laser printer for personal computers ordinarily uses individual 8 1/2 × 11-inch sheets of paper stored in one or more removable trays that slide in the printer case.

Laser printers print text and graphics in high-quality resolutions. While laser printers usually cost more than ink-jet printers, many models are available at affordable prices for the home user. Laser printers usually print at faster speeds than ink-jet printers.

Depending on the quality, speed, and type of laser printer, the cost ranges from a few hundred to a few thousand dollars for the home and small office user, and several hundred thousand dollars for the enterprise user.

When printing a document, laser printers process and store the entire page before they actually print it. For this reason, laser printers sometimes are called page printers. Storing a page before printing requires that the laser printer has a certain amount of memory in the device. The more memory in the printer, the faster it usually can print.

Operating in a manner similar to a copy machine,

How a Black-and-White Laser Printer Works

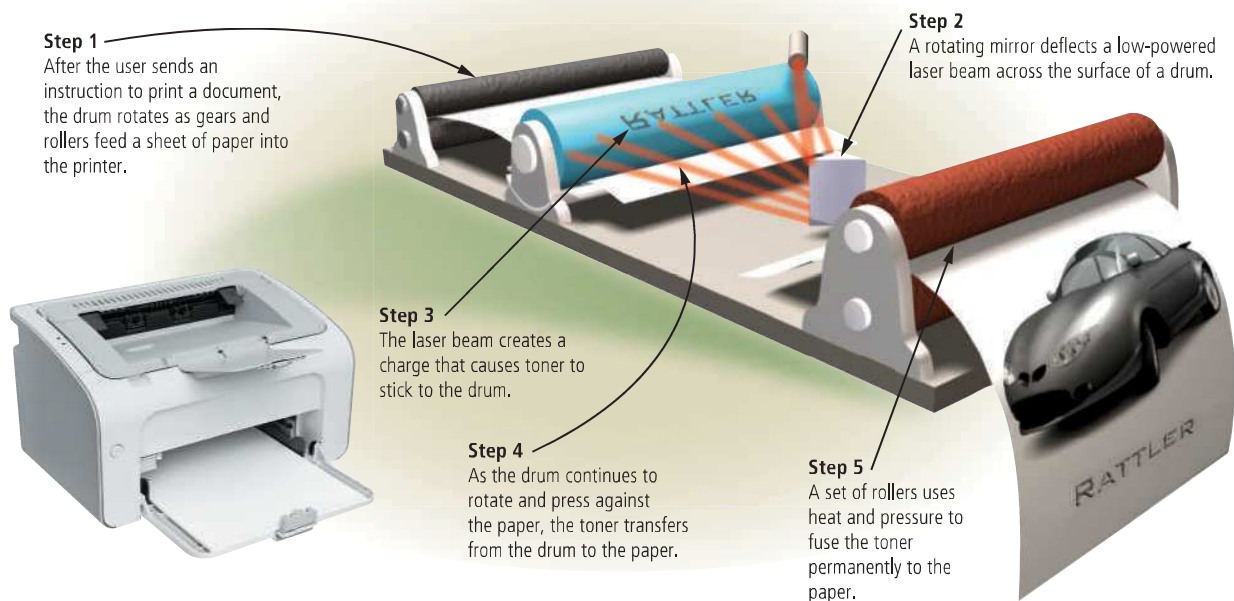


Figure 7-31 This figure shows how a black-and-white laser printer works.
© Cengage Learning; © Serg64 / Shutterstock.com

All-in-One Printers

An **all-in-one printer**, also called a *multifunction printer* (MFP), is a single device that looks like a printer or a copy machine but provides the functionality of a printer, scanner, copy machine, and perhaps a fax machine (Figure 7-32). Some use color ink-jet printer technology, while others use laser technology.



Figure 7-32 An all-in-one printer.
Courtesy of Epson America, Inc.



CONSIDER THIS

Who uses all-in-one printers?

Small/home office users have all-in-one printers because these devices require less space than having a separate printer, scanner, copy machine, and fax machine. Another advantage of these devices is they are significantly less expensive than if you purchase each device separately. If the device breaks down, however, you lose all four functions, which is the primary disadvantage.



BTW

High-Tech Talk

Discover More: Visit this chapter's free resources to learn how 3-D printers work.

3-D Printers

A **3-D printer** uses a process called additive manufacturing to create an object by adding material to a three-dimensional object, one horizontal layer at a time. 3-D printers can print solid objects, such as clothing, prosthetics, eyewear, implants, toys, parts, prototypes, and more (Figure 7-33).

Using a digital model created with CAD (computer-aided design) software, 3-D printers begin creating an object at the bottom and add layers of material to the object until it is complete. Depending on the type of printer, the layers are built with liquid polymer, gel, or resin.

In the past, 3-D printers were quite expensive and used only by large corporations. Today, home and small business users work with more affordable desktop 3-D printers.



Figure 7-33 A 3-D printer.
© dreamnikon / Fotolia

Thermal Printers

A **thermal printer** generates images by pushing electrically heated pins against heat-sensitive paper. Basic thermal printers are inexpensive, but the print quality is low, the images tend to fade over time, and thermal paper can be expensive. Self-service gas pumps often print gas receipts using a built-in, lower-quality thermal printer. Many point-of-sale terminals in retail and grocery stores also print purchase receipts on thermal paper.

Some thermal printers have high print quality and can print at much faster rates than ink-jet and laser printers. A *dye-sublimation printer*, sometimes called a *digital photo printer*, uses heat to transfer colored dye to specially coated paper. Photography studios, medical labs, security identification systems, and other professional applications requiring high image quality use dye-sublimation printers that can cost thousands of dollars (Figure 7-34). Dye-sublimation printers for the home or small business user, by contrast, typically are much slower and less expensive than their professional counterparts. Some are small enough for the mobile user to carry in a briefcase.



Figure 7-34 A dye-sublimation printer.
Courtesy of Mitsubishi Electric Visual Solutions America, Inc.

Mobile Printers

A **mobile printer** is a small, lightweight, battery-powered printer that allows a mobile user to print from a laptop, smartphone, or other mobile device while traveling (Figure 7-35). Barely wider than the paper on which they print, mobile printers fit easily in a briefcase alongside a laptop.

Mobile printers mainly use ink-jet or thermal technology. Many connect to a USB port. Others have a built-in wireless port through which they communicate with the computer.



Figure 7-35 A mobile printer is small enough to fit in a backpack.

Courtesy of Brother International Corporation

Label Printers

A **label printer** is a small printer that prints on an adhesive-type material that can be placed on a variety of items, such as envelopes, packages, optical discs, photos, and file folders (Figure 7-36).

Most label printers also print bar codes. Label printers typically use thermal technology.



Figure 7-36 A label printer.

© iStockphoto.com /ZavgSG

Plotters and Large-Format Printers

Plotters are sophisticated printers used to produce high-quality drawings, such as blueprints, maps, and circuit diagrams. These printers are used in specialized fields such as engineering and drafting and usually are very costly. Current plotters use a row of charged wires (called styli) to draw an electrostatic pattern on specially coated paper and then fuse toner to the pattern. The printed image consists of a series of very small dots, which provides high-quality output.

Using ink-jet printer technology, but on a much larger scale, a **large-format printer** creates photo-realistic-quality color prints. Graphic artists use these high-cost, high-performance printers for signs, posters, and other professional quality displays (Figure 7-37).



Figure 7-37 Graphic artists use large-format printers to print signs, posters, and other professional quality displays.

Courtesy of Xerox Corporation

Impact Printers

An **impact printer** forms characters and graphics on a piece of paper by striking a mechanism against an inked ribbon that physically contacts the paper. Impact printers characteristically are noisy because of this striking activity (Figure 7-38). Impact printers are ideal for printing multipart forms because they print through many layers of paper easily. Factories, warehouses, and retail counters may use impact printers because these printers withstand dusty environments, vibrations, and extreme temperatures.

Discover More: Visit this chapter's free resources to learn more about impact printers.

Other Output Devices

In addition to displays and printers, other output devices are available for specific uses and applications. These include speakers, headphones and earbuds, data projectors, interactive whiteboards, and force-feedback game controllers and tactile output.

Speakers

Most personal computers and mobile devices have a small internal speaker that usually emits only low-quality sound. Thus, many users attach surround sound **speakers** or speaker systems to their computers, game consoles, and mobile devices to generate higher-quality sounds for playing games, interacting with multimedia presentations, listening to music, and viewing movies (Figure 7-39).

Most surround sound computer speaker systems include one or two center speakers and two or more *satellite speakers* that are positioned so that sound emits from all directions. Speakers typically have tone and volume controls, allowing users to adjust settings. To boost the low bass sounds, surround sound speaker systems also include a *subwoofer*.

In some configurations, a cable connects the speakers or the subwoofer to a port on the computer or device. With wireless speakers, however, a transmitter connects to a port on the computer, which wirelessly communicates with the speakers.

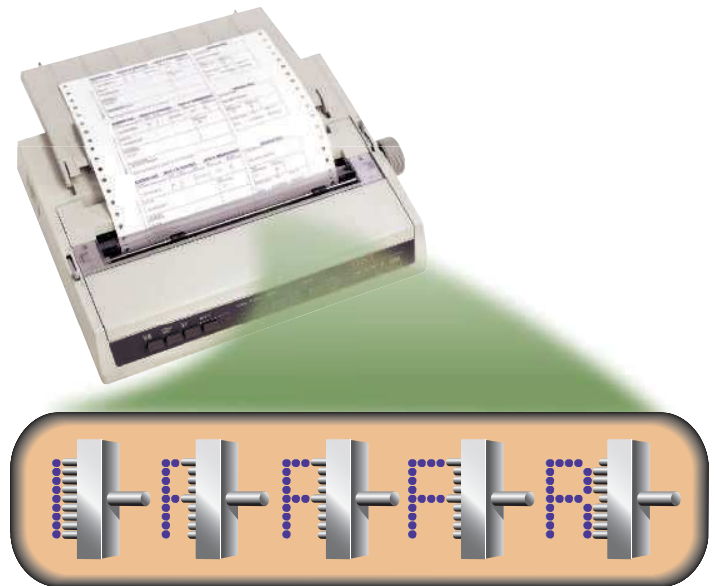


Figure 7-38 An impact printer produces printed images when tiny pins strike an inked ribbon.

Courtesy of Oki Data Americas, Inc.; © Cengage Learning

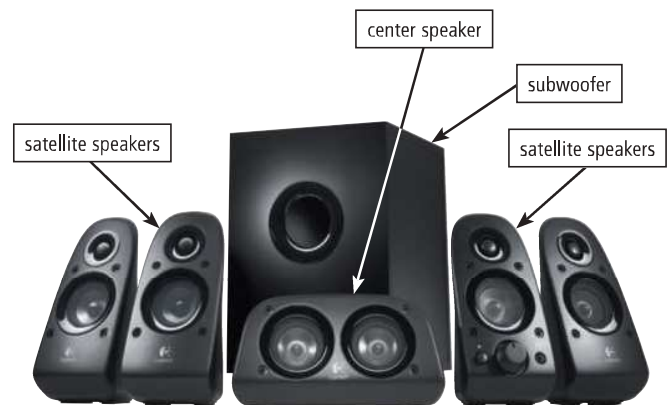


Figure 7-39 Users often attach high-quality surround sound speaker systems to their computers, game consoles, and mobile devices.

Courtesy of Logitech

CONSIDER THIS

What do the numbers mean in surround sound configurations?

The first number refers to the number of speakers, and the second number refers to the number of subwoofers. For example, a 2.1 speaker system contains two speakers and one subwoofer. A 5.1 speaker system has five speakers (i.e., four satellite speakers, one center speaker) and one subwoofer. A 7.2 speaker system has seven speakers (i.e., four satellite speakers, two side speakers, one center speaker) and two subwoofers.

Internet Research

Which wireless speakers are the best?

Search for: wireless speaker reviews



Figure 7-40 In a crowded environment where speakers are not practical, users can wear headphones to hear audio output.

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Internet Research

Which Bluetooth headset is best?

Search for: bluetooth headset reviews

As an alternative to headphones, earbuds, or headsets, you can listen to audio from mobile devices, such as a portable media player or smartphone, through speakers in a vehicle or on a stereo system at home or work. Or, you can purchase speakers specifically designed to play audio from the device.

Data Projectors

A **data projector** is a device that projects the text and images displaying on a computer or mobile device screen on a larger screen so that an audience can see the image clearly (Figure 7-41). For example, many classrooms use data projectors so that all students easily can see an instructor's presentation on the screen.



Figure 7-41 A data projector projects an image from a computer or mobile device screen on a larger screen so that an audience easily can see the image.

©Stockphoto / poba; © iStockphoto / Michal Szwedlo

Headphones and Earbuds

When using speakers, anyone in listening distance can hear the output. In a computer laboratory or other crowded environment, speakers might not be practical. Instead, users can listen through headphones or earbuds so that only the individual wearing the headphones or earbuds hears the sound from the computer. The difference is that **headphones** cover or are placed outside of the ear (Figure 7-40), whereas **earbuds** (shown with the audio output devices in Figure 7-23 earlier in the chapter) rest inside the ear canal. Both headphones and earbuds usually include noise-cancelling technology to reduce the interference of sounds from the surrounding environment.

A **headset** is a device that functions as both headphones and a microphone (shown in Figure 7-1 at the beginning of the chapter). Computer and smartphone users wear a headset to free their hands for typing and other activities while talking or listening to audio output. Many headsets communicate wirelessly with the computer or mobile device.

Some data projectors are large devices that attach to a ceiling or wall in an auditorium. Others, designed for the mobile user, are small portable devices that can be transported easily. Two types of smaller, lower-cost units are LCD projectors and DLP projectors.

- An *LCD projector*, which uses liquid crystal display technology, attaches directly to a computer or mobile device and uses its own light source to display the information shown on the computer screen. Because LCD projectors tend to produce lower-quality images, users often prefer DLP projectors for their sharper, brighter images.
- A *digital light processing (DLP) projector* uses tiny mirrors to reflect light, which produces crisp, bright, colorful images that remain in focus and can be seen clearly, even in a well-lit room. Some newer televisions use DLP instead of LCD or plasma technology.

Interactive Whiteboards

An **interactive whiteboard** is a touch-sensitive device, resembling a dry-erase board, that displays the image on a connected computer screen, usually via a projector. A presenter controls the program by clicking a remote control, touching the whiteboard, drawing on or erasing the whiteboard with a special digital pen and eraser, or writing on a special tablet. Notes written on the interactive whiteboard can be saved directly on the computer and/or printed. Interactive whiteboards are used frequently in classrooms as a teaching tool (Figure 7-42), during meetings as a collaboration tool, and to enhance delivery of presentations.

Force-Feedback Game Controllers and Tactile Output

Joysticks, wheels, gamepads, and motion-sensing game controllers are input devices used to control movements and actions of a player or object in computer games, simulations, and video games. These devices also function as output devices when they include *force feedback*, which is a technology that sends resistance to the device in response to actions of the user (Figure 7-43). For example, as you use the simulation software to drive from a smooth road onto a gravel alley, the steering wheel trembles or vibrates, making the driving experience as realistic as possible. These devices also are used in practical training applications, such as in the military and aviation.

Some input devices, such as a mouse, and mobile devices, such as a smartphone, include *tactile output* that provides the user with a physical response from the device. For example, users may sense a bumping feeling on their hand while scrolling through a smartphone's contact list.



Figure 7-42 Teachers and students can write directly on an interactive whiteboard, or they can write on a slate that communicates wirelessly with the whiteboard.

Courtesy of SMART Technologies



Figure 7-43 Gaming devices often use force feedback, giving the user a realistic experience.

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Assistive Technology Input and Output

The ever-increasing presence of computers in everyone's lives has generated an awareness of the need to address computing requirements for those who have or may develop physical limitations. **The Americans with Disabilities Act (ADA)** requires any company with 15 or more employees to make reasonable attempts to accommodate the needs of physically challenged workers. Read Ethics & Issues 7-4 to consider who should pay for assistive technologies.



BTW

Technology Trend

Discover More: Visit this chapter's free resources to learn more about assistive technologies.

ETHICS & ISSUES 7-4

Who Should Pay for Assistive Technologies?

Public institutions, such as schools and libraries, are required to accommodate visitors or students who require wheelchairs or other devices to enter and move about the building. These institutions install wide doors and ramps and modify restroom facilities to ensure accessibility. Should the same accommodations be available for those who need assistive technologies?

Assistive technologies include devices you can operate with your foot; one example is a mouse. Braille keyboards, printers, and display devices exist for visually impaired

users. Several sources are available to fund assistive technologies. Health insurance covers many assistive technologies. Government programs, such as Medicare, Medicaid, or Social Security, offer some funding. In addition, private or nonprofit groups may provide grants or donations.

Many libraries offer digital versions of books, including digital Braille and audio, for those with visual impairments or dyslexia. Patrons must submit a request that includes recommendations from a doctor. The Individuals with Disabilities Education Act (IDEA) requires that public schools provide free and appropriate education for

all students. Technology increasingly is an important part of a student's education. Thus, schools are required to purchase or acquire funding for adaptive technologies for students who need them. If a student's parents provide an assistive technology that a student uses at school, the school must pay to repair and service the device.

Consider This: Should parents of children who need assistive technology devices be required to provide funding or partial funding? Why or why not? What resources should public libraries provide to patrons with disabilities?



Figure 7-44 A camera/receiver mounted on the monitor tracks the position of the head-mounted pointer, which is the reflective material on the brim of the hat. As the user moves her head, the pointer on the screen also moves.

Courtesy of NaturalPoint, Inc.

Besides voice recognition, which is ideal for blind or visually impaired users, several other input options are available. Users with limited hand mobility who want to use a keyboard can use an on-screen keyboard or a keyboard with larger keys. Users with limited hand movement can use a head-mounted pointer to control the pointer or insertion point (Figure 7-44). To simulate the functions of a mouse button, a user works with switches that control the pointer. The switch might be a hand pad, a foot pedal, a receptor that detects facial motions, or a pneumatic instrument controlled by puffs of air.

For users with mobility, hearing, or vision disabilities, many different types of output options

are available. Hearing-impaired users, for example, can instruct programs to display words instead of sounds. Visually impaired users can change screen settings, such as increasing the size or changing the color of the text to make the words easier to read. Instead of using a monitor, blind users can work with voice output. That is, the computer speaks out loud the information that appears on the screen. Another alternative is a Braille printer, which prints information on paper in Braille (Figure 7-45).

Internet Research

What are new developments related to assistive technologies?

Search for: assistive technology devices



Figure 7-45 A Braille printer.

Courtesy of Enabling Technologies; © Don Farrall / Getty Images

NOW YOU SHOULD KNOW

Be sure you understand the material presented in the sections Printers, Other Output Devices, and Assistive Technology Input and Output, as it relates to the chapter objectives.

Now you should know...


- Which type of printer might be suited to your needs (Objective 9)
- When you would use speakers, headphones, earbuds, data projectors, interactive whiteboards, and game controllers (Objective 10)
- Which types of assistive technology options are available (Objective 11)

Discover More: Visit this chapter's premium content for practice quiz opportunities.

Chapter Summary

This chapter presented a variety of options for input and output. Input options included the keyboard, mouse and other pointing devices, touch screens, pen input, motion input, voice input, video input, and scanners and reading devices. Output options included displays, printers, speakers, headphones and earbuds, data projectors, interactive whiteboards, and force-feedback game controllers and tactile output. The chapter also presented several assistive technology options for input and output.

Discover More: Visit this chapter's free resources for additional content that accompanies this chapter and also includes these features: Technology Innovators: HP, Logitech, Masahiro Hara and Denso Wave, and Ursula Burns; Technology Trends: Drones and Assistive Technology; and High-Tech Talks: Biometric Input and How 3-D Printers Work.

-  Test your knowledge of chapter material by accessing the Study Guide, Flash Cards, and Practice Test resources from your smartphone, tablet, laptop, or desktop.

TECHNOLOGY @ WORK

Finance

Watching the television, you notice a ticker at the bottom of the screen showing how various stocks currently are performing. You realize that the price of a stock you own has risen significantly, most likely the result of a recent press release about a new product they plan to release. A notification on your smartphone also alerts you of the sharp rise, and you decide to keep a closer eye on the price for the rest of the day in case you wish to sell some shares. You then use the app on your smartphone to check the balances in your accounts.

Because timely decisions often are important in the financial industry, technology helps provide important information to all who participate in various financial transactions. In the stock market, large displays on the trading floors of various exchanges help provide timely information to those buying and selling shares of stock. With the advancements in technology, stock traders now can see up-to-the-minute stock information on their computers and mobile

devices using various finance programs and apps. Users can configure these programs and apps to display notifications when a certain stock's price reaches a certain value so that they can decide whether they want to buy or sell shares. The program or app then can facilitate the sale or purchase of stock shares, all within seconds. Technology also enables users to buy or sell stock shares automatically when they reach a certain price, all without additional user intervention.

In addition to technology playing a role in the stock market, it also helps with banking for individuals and businesses. In fact, technology makes it possible to perform the majority of banking transactions, all without having to visit a bank teller. ATMs allow people the flexibility to deposit and withdraw funds from many locations around the globe. Web and mobile apps also are available and provide users with the ability to access account information, transfer funds between accounts, pay bills electronically, apply for loans, and complete the necessary

information to open new accounts. Some financial institutions allow their users to use a mobile app on their smartphone to deposit checks by taking a picture of the front and back of an endorsed check. The next time you are able to perform a financial transaction easily with little or no human intervention, think about all the ways technology has made this possible.

 **Consider This:** How else might computers and technology be used in the finance industry?



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Study Guide

The Study Guide exercise reinforces material you should know for the chapter exam.

Discover More: Visit this chapter's premium content to **test your knowledge of digital content** associated with this chapter and **access the Study Guide resource** from your smartphone, tablet, laptop, or desktop.

Instructions: Answer the questions below using the format that helps you remember best or that is required by your instructor. Possible formats may include one or more of these options: write the answers; create a document that contains the answers; record answers as audio or video using a webcam, smartphone, or portable media player; post answers on a blog, wiki, or website; or highlight answers in the book/e-book.

1. ___ is any data and instructions entered into the memory of a computer.
2. Define these terms: data, software, and command. Give an example of a user response.
3. List features that are common to most keyboards. Describe how to use a keyboard shortcut.
4. Explain the criminal and beneficial purposes of keyboard monitoring software.
5. Differentiate among compact, ergonomic, gaming, and wireless keyboards.
6. Define the term, pointer. Name objects a pointing device can select.
7. List different mouse types.
8. Describe the following input devices: touchpad, pointing stick, and trackball.
9. Explain how to interact with a touch screen.
10. Describe how desktop monitors, laptop and mobile device screens, smartphones, wearable devices, portable media players, digital cameras, kiosks, and navigation systems use touch input.
11. Explain technologies and laws aimed to prevent use of mobile devices while driving.
12. List methods and devices for using pen input. Define the term, digitizer.
13. Explain how hand-writing notes during class could impact your knowledge retention.
14. Define the term, motion input. Describe how the entertainment industry, the military, athletes, and the medical field use motion input.
15. Name hardware and devices used for voice and audio input.
16. Outline steps involved in using DV technology.
17. List steps for setting up and using a webcam.
18. Explain what occurs during a videoconference and the technology needed.
19. Outline steps to secure your privacy when using a device with a webcam.
20. Describe types of scanners and reading devices.
21. A(n) ___ code stores information that can correspond to a web address or other content.
22. List guidelines for safely scanning QR codes.
23. Explain why a retailer would use RFID technology, and list uses for magstripe readers.
24. List guidelines to protect your credit card from scanning devices.
25. Describe how a bank uses MICR technology.
26. Give examples of data collection devices and describe how they are used.
27. Define the term, output. List types and methods of output.
28. Define the terms, display and monitor. Describe different types of monitors.
29. List steps to connect a laptop to an external display.
30. Differentiate among LCD, CCF, LED, TFT, OLED, and AMOLED technologies.
31. Describe how display quality is determined. Define these terms: resolution, response time, nit, candela, dot pitch, and contrast ratio.
32. Explain the purpose of the GPU. List and describe port types for monitors.
33. Describe the technologies used by HDTV. Explain the capabilities of a Smart TV.
34. List steps to show media on a Smart TV from a computer or mobile device.
35. Explain safety issues surrounding hardware radiation.
36. Describe orientation options for printouts. Explain what is needed to print using Bluetooth.
37. Explain how an ink-jet printer works, and describe the mechanics of the ink cartridge.
38. Explain how resolution affects printer quality.
39. Explain how a photo printer uses PictBridge.
40. Outline steps for printing from a smartphone or tablet.
41. Compare the price and quality of laser printers to ink-jet printers.
42. Describe the following printer types: all-in-one, 3-D, thermal, mobile, label, plotter, and impact.
43. Explain how computers and mobile devices use speakers, such as satellite speakers, to emit sound.
44. Differentiate among headphones, earbuds, and headsets.
45. Define the term, data projector. Differentiate between LCD and DLP projector technology.
46. Describe uses of interactive whiteboards and force-feedback game controllers. Define the term, tactile output.
47. List types of assistive technologies for input and output.
48. Explain issues surrounding payment for assistive technologies.
49. Explain how the finance field uses technology.

You should be able to define the Primary Terms and be familiar with the Secondary Terms listed below.

Key Terms

Discover More: Visit this chapter's premium content to view definitions for each term and to access the Flash Cards resource from your smartphone, tablet, laptop, or desktop.

Primary Terms (shown in bold-black characters in the chapter)

- | | | | |
|---|------------------------------|-------------------------|-----------------------------|
| 3-D printer (349) | HDTV (343) | monitor (340) | RFID reader (336) |
| all-in-one printer (349) | headphones (352) | mouse (322) | scanner (334) |
| Americans with Disabilities Act (ADA) (353) | impact printer (351) | nonimpact printer (345) | signature capture pad (326) |
| bar code (335) | ink-jet printer (345) | OCR devices (335) | speakers (351) |
| bar code reader (335) | input (318) | OMR devices (335) | stylus (326) |
| data projector (352) | interactive whiteboard (353) | output (339) | thermal printer (349) |
| digital pen (327) | keyboard (320) | pen input (326) | touch screen (324) |
| digital video (DV) camera (330) | label printer (350) | photo printer (347) | touchpad (323) |
| display (340) | large-format printer (350) | plotters (350) | trackball (324) |
| DV technology (331) | laser printer (348) | pointer (322) | video call (332) |
| earbuds (352) | LCD (341) | printer (344) | videoconference (333) |
| graphics tablet (328) | magstripe reader (339) | QR code (335) | voice recognition (330) |
| | mobile printer (350) | resolution (342) | webcam (332) |
| | | RFID (336) | |

Secondary Terms (shown in *italic* characters in the chapter)

- | | | | |
|---|--|-----------------------------------|--|
| <i>active-matrix</i> (342) | <i>function keys</i> (320) | <i>OLED</i> (342) | <i>streaming cam</i> (333) |
| <i>air gestures</i> (328) | <i>gaming keyboard</i> (322) | <i>optical mouse</i> (322) | <i>subwoofer</i> (351) |
| <i>AMOLED</i> (342) | <i>gesture</i> (324) | <i>PictBridge</i> (347) | <i>tactile output</i> (353) |
| <i>aspect ratio</i> (343) | <i>gesture recognition</i> (328) | <i>pixel</i> (342) | <i>TFT</i> (342) |
| <i>audio input</i> (330) | <i>graphics processing unit</i> (342) | <i>pixel pitch</i> (342) | <i>toggle key</i> (320) |
| <i>backlight</i> (341) | <i>handwriting recognition software</i> (327) | <i>plasma display</i> (344) | <i>toner</i> (348) |
| <i>bar code scanner</i> (335) | <i>HDMI (High-Definition Media Interface) port</i> (343) | <i>portrait orientation</i> (344) | <i>touch mouse</i> (323) |
| <i>Bluetooth printing</i> (345) | <i>headset</i> (352) | <i>printout</i> (344) | <i>touch-sensitive pad</i> (326) |
| <i>candela</i> (342) | <i>high-definition television</i> (343) | <i>response time</i> (342) | <i>trackpad</i> (323) |
| <i>command</i> (318) | <i>insertion point</i> (320) | <i>Retina Display</i> (342) | <i>UPC (Universal Product Code)</i> (335) |
| <i>compact keyboard</i> (321) | <i>keyboard monitoring software</i> (321) | <i>satellite speakers</i> (351) | <i>user response</i> (318) |
| <i>contrast ratio</i> (342) | <i>keyboard shortcut</i> (320) | <i>Smart TV</i> (343) | <i>voice input</i> (330) |
| <i>cursor</i> (320) | <i>keylogging software</i> (321) | <i>soft copy</i> (340) | <i>voice recognition application</i> (330) |
| <i>data</i> (318) | <i>landscape orientation</i> (344) | <i>software</i> (318) | <i>widescreen monitor</i> (343) |
| <i>data collection device</i> (338) | <i>laser mouse</i> (322) | <i>source document</i> (334) | <i>wireless keyboard</i> (322) |
| <i>digital light processing (DLP) projector</i> (352) | <i>LCD projector</i> (352) | <i>speech recognition</i> (330) | <i>wireless mouse</i> (323) |
| <i>digital photo printer</i> (349) | <i>LED</i> (341) | <i>speech-to-text</i> (330) | |
| <i>digitizer</i> (328) | <i>LED display</i> (342) | | |
| <i>display device</i> (340) | <i>liquid crystal display</i> (341) | | |
| <i>DisplayPort</i> (343) | <i>magnetic stripe card reader</i> (337) | | |
| <i>dot pitch</i> (342) | <i>MICR devices</i> (338) | | |
| <i>dots per inch (dpi)</i> (346) | <i>morphing</i> (331) | | |
| <i>DVI (Digital Video Interface) port</i> (343) | <i>motion input</i> (328) | | |
| <i>dye-sublimation printer</i> (349) | <i>multifunction printer</i> (348) | | |
| <i>ergonomic keyboard</i> (322) | <i>multi-touch</i> (324) | | |
| <i>flat-panel display</i> (340) | <i>native resolution</i> (342) | | |
| <i>force feedback</i> (353) | <i>nit</i> (342) | | |
| <i>frame rate</i> (331) | <i>OCR software</i> (334) | | |



QR code (335)

Checkpoint

The Checkpoint exercises test your knowledge of the chapter concepts. The page number containing the answer appears in parentheses after each exercise. The Consider This exercises challenge your understanding of chapter concepts.

Discover More: Visit this chapter's premium content to **complete the Checkpoint exercises** interactively; complete the **self-assessment in the Test Prep resource** from your smartphone, tablet, laptop, or desktop; and then **take the Practice Test**.

True/False

Mark T for True and F for False.

- _____ 1. CAPS LOCK and NUM LOCK are two examples of toggle keys. (320)
- _____ 2. Keylogging software runs undetected and stores every keystroke in a file for later retrieval. (321)
- _____ 3. Wearable devices mainly rely upon touch input. (325)
- _____ 4. A smaller frame rate results in a smaller file size for a video, as well as a smoother playback. (331)
- _____ 5. Optical character recognition (OCR) and optical mark recognition (OMR) are two technologies used by QR code readers. (335)
- _____ 6. Many retailers do not believe RFID is an alternative to bar code identification because it requires line-of-sight transmission. (336)
- _____ 7. A data collection device reads and scans data from a source document. (338)
- _____ 8. In terms of response time, the lower the number, the faster the response time. (342)
- _____ 9. Contrast ratio defines a display's width relative to its height. (342)
- _____ 10. Every electronic device emits some level of radiation. (344)
- _____ 11. Printer resolution is measured by the number of pixels per inch a printer can print. (346)
- _____ 12. A dye-sublimation printer uses heat to transfer colored dye to specially coated paper. (349)

Multiple Choice

Select the best answer.


1. A _____ is an instruction a user issues by responding to a message displayed by a program or app. (318)
 - a. command
 - b. user response
 - c. keyboard shortcut
 - d. function
2. Which of the following is not an example of a pointing device? (324)
 - a. touchpad
 - b. trackball
 - c. touch screen
 - d. pointing stick
3. A(n) _____ is an input device that contains buttons and/or wheels you operate with a thumb or finger. (326)
 - a. digitizer
 - b. interactive whiteboard
 - c. touch-sensitive pad
 - d. OCR device
4. _____ read hand-drawn marks, such as small circles or rectangles. (335)
 - a. MICR readers
 - b. Digitizers
 - c. OMR devices
 - d. OCR devices
5. LCD displays typically produce color using _____ technology, which uses a separate transistor to supply charges to each liquid crystal cell. (342)
 - a. passive-matrix
 - b. OLED
 - c. Retina Display
 - d. active-matrix
6. _____ displays use organic molecules that are self-illuminating and, thus, do not require a backlight. (342)
 - a. OLED
 - b. TFT
 - c. LED
 - d. CCFL
7. _____ orientation refers to a printout that is wider than it is tall. (344)
 - a. Cinematic
 - b. Portrait
 - c. Landscape
 - d. Widescreen
8. How many subwoofers would a 7.2 speaker system contain? (351)

a. 1	c. 7
b. 2	d. 9

Checkpoint

Matching Match the terms with their definitions.

- | | |
|---|--|
| _____ 1. command (318) | a. a type of 2-D bar code that stores information in both horizontal and vertical directions |
| _____ 2. keyboard shortcut (320) | b. small, flat, rectangular pointing device that is sensitive to pressure and motion |
| _____ 3. touchpad (323) | c. touch screen capability of recognizing more than one point of contact at the same time |
| _____ 4. multi-touch (324) | d. device that functions as both headphones and a microphone |
| _____ 5. voice recognition (330) | e. touch-sensitive device that displays the image on a connected computer screen, usually via projector |
| _____ 6. scanner (334) | f. chip that controls the manipulation and display of graphics on a display device |
| _____ 7. QR code (335) | g. instruction that causes a program or app to perform a specific action |
| _____ 8. graphics processing unit (342) | h. computer or mobile device's capability of distinguishing spoken words |
| _____ 9. headset (352) | i. light-sensing input device that reads printed text and graphics and then translates the result into a form the computer can process |
| _____ 10. interactive whiteboard (353) | j. one or more keyboard keys that you press to perform an operating system or application-related task |

 **Consider This** Answer the following questions in the format specified by your instructor.

1. Answer the critical thinking questions posed at the end of these elements in this chapter: Ethics & Issues (326, 327, 344, 354), How To (332, 341, 343, 347), Mini Features (325, 329, 331), Secure IT (321, 333, 336, 337), and Technology @ Work (355).
2. What are some examples of data? (318)
3. What are some commonly used input methods? (319)
4. What happens when you press a toggle key? (320)
5. What steps can you take to detect keyboard monitoring software? (321)
6. What are some types of keyboards? (321)
7. How does an optical mouse differ from a touch mouse? (322)
8. How does a stylus differ from a digital pen? (326)
9. Who might use a graphics tablet? (328)
10. What are some disciplines in which motion input is being used? (329)
11. What is meant by the term, morphing? (331)
12. How does a video call differ from a videoconference? (333)
13. What steps should you take to secure a webcam? (333)
14. How do OCR and OMR devices differ? (335)
15. What do bar codes represent? (335)
16. What guidelines should you follow to use a QR code safely? (336)
17. What are some uses of RFID? (336)
18. What is contained in an RFID tag? (336)
19. Why might some magstripes become unreadable? (338)
20. What are the four basic types of output? (340)
21. What are some advantages and a disadvantage of OLED technology? (342)
22. On today's displays, what is the range for nits? (342)
23. What are commonly used nonimpact printers? (345)
24. If your mobile device does not support wireless printing, how can you print photos from it? (347)
25. What types of businesses use a dye-sublimation printer? (349)
26. Why might a user prefer a DLP projector over an LCD projector? (352)
27. What does the Americans with Disabilities Act (ADA) require? (353)
28. Should schools and companies be required to pay for assistive technologies? Why or why not? (354)

Problem Solving

The Problem Solving exercises extend your knowledge of chapter concepts by seeking solutions to practical problems with technology that you may encounter at home, school, or work. The Collaboration exercise should be completed with a team.

Instructions: You often can solve problems with technology in multiple ways. Determine a solution to the problems in these exercises by using one or more resources available to you (such as a computer or mobile device, articles on the web or in print, blogs, podcasts, videos, television, user guides, other individuals, electronics or computer stores, etc.). Describe your solution, along with the resource(s) used, in the format requested by your instructor (brief report, presentation, discussion, blog post, video, or other means).

Personal

- 1. Assistive Technologies** You have just purchased a new computer and, because of a visual impairment, you are having trouble reading the information on the screen. What are your next steps?
- 2. Smart TV Issues** You are watching a movie on your Smart TV using a streaming media service.



© Courtesy of LG Electronics USA Inc.

Every few minutes, a message is displayed on the TV stating that the movie is buffering. Why might this be happening, and what can you do to resolve this issue?

- 3. Touch Gestures Not Working** You are using the stretch touch gesture to zoom on your mobile device. Each time you perform the gesture, however, instead of zooming, one of your fingers appears to be dragging an item around the screen. What might be the problem?
- 4. Dim Screen** While using your laptop, the screen suddenly becomes dim. You set the brightness to its highest setting before it dimmed and wonder why it suddenly changed. After resetting the brightness to its highest setting, you continue working. What might have caused the screen to dim?
- 5. Malfunctioning Earbud** While listening to music on your portable media player, one side of the earbuds suddenly stops working. What might have caused this?

Collaboration

- 11. Technology in Finance** Technology enables individuals and businesses to conduct transactions in the finance industry with great convenience and speed; however, many individuals do not realize the extent to which technology impacts the industry. Form a team of three people to learn more about the important role that technology plays in today's finance industry. One team member should research the different ways that technology impacts and improves personal financial transactions, such as home banking. Another team member should research how large businesses use technology to manage their finances, and the other team member should research the different ways technology has helped improve the stock market. Write a brief report summarizing your findings.

Professional

- 6. Printer Problem** You are attempting to print on a wireless printer from your laptop, but each time you tap or click the Print button, you receive an error message that the printer is not connected. What are your next steps?
- 7. Projector Resolution Issue** You are preparing for a meeting in your company's conference room and have connected your laptop to the projector. When the projector displays the information from your laptop screen, the resolution drops significantly and not everything fits on the screen. What steps can you take to correct this problem?
- 8. Fingerprints Not Recognized** To increase security, your company now requires employees to sign in to their computer accounts using a fingerprint reader instead of entering a user name and password. This past weekend, you cut the finger you use to sign in, and your computer now does not recognize your fingerprint. As a result, you are unable to access your computer. What are your next steps?
- 9. Access Denied** Your company uses security badges with embedded RFID tags to authenticate the rooms to which employees have access. This badge also grants employees access to the company's parking lot. When arriving at work one morning, you wave your badge in front of the RFID reader, but the gate that allows access to the parking lot does not open. In addition, a red light blinks on the RFID reader. What are your next steps?
- 10. Monitors Reversed** You have two monitors on your desk at work: the monitor on the left is your primary monitor and displays the taskbar and the applications you are currently using, and you typically use the monitor on the right to display an email program. When you arrive at work and sign in to your Windows account, you realize that the monitor on the right is now the primary monitor. What might have happened?

The How To: Your Turn exercises present general guidelines for fundamental skills when using a computer or mobile device and then require that you determine how to apply these general guidelines to a specific program or situation.

How To: Your Turn

Discover More: Visit this chapter's premium content to **challenge yourself with additional How To: Your Turn exercises**, which include App Adventure.

Instructions: You often can complete tasks using technology in multiple ways. Figure out how to perform the tasks described in these exercises by using one or more resources available to you (such as a computer or mobile device, articles on the web or in print, online or program help, user guides, blogs, podcasts, videos, other individuals, trial and error, etc.). Summarize your 'how to' steps, along with the resource(s) used, in the format requested by your instructor (brief report, presentation, discussion, blog post, video, or other means).

1 Work with QR Codes

QR codes initially were used in the automotive industry to track vehicles during the production process. Today, QR codes often are used in publications and advertisements to convey information, direct users to a website, suggest users download a file, or direct users to an app store or marketplace to download an app. Exercise caution when scanning QR codes, because they may direct your mobile computer or device to a malicious website or file. For example, it probably is wise to avoid scanning QR codes appearing on homemade flyers and other similar sources.

Scanning QR Codes

When you encounter a QR code that you want to scan, you should use an app capable of reading QR codes. The following steps guide you through the process of scanning QR codes.

- Download and install an app that can read QR codes.
- When you see a QR code you want to scan, run the app on your mobile computer or device. If necessary, select the option to scan a QR code.
- Hold the device still and point its camera toward the QR code to scan it.
- Once your device scans the QR code, it will display the associated information. If the QR code represents a web address, the app will run a browser and navigate to that address.

Generating QR Codes

If you want to generate a QR code to make it easier for others to navigate to a particular location or perform an action, you should use a QR code generator. The following steps describe how to generate QR codes:

- Use a search engine to locate a website that contains a QR code generator and then navigate to it.
- Enter the information, such as a web address, phone number, word, or short phrase, that you want the QR code to contain, and then tap or click the button to generate the QR code.
- Copy the generated QR code image and then paste it in the desired location.
- Scan the QR code to make sure it displays the results you expect.

Exercises

- Compare and contrast at least three apps that can scan QR codes. Which one is your favorite? Why?
- Compare and contrast at least three websites or apps that can generate QR codes. Which app would you use to generate QR codes? Why?
- List at least three places you remember seeing QR codes. Did you scan them? Why or why not?



Source: Cengage Learning

2 Record and Edit a Video

Once you have finished recording a video, you may want to edit it before sharing it with others. For example, you might want to remove portions of the video, add special effects, or play an audio track instead of the audio recorded with the video. The following steps guide you through the process of recording and editing a video.

Record a Video

- Verify your camera's battery is charged and that the device has sufficient space available to store the video you are about to record.
- If you plan to record the video from one location, consider placing the camera on a stable surface so that it does not move.
- If you intend to record outside where it is windy, shield the camera from the wind.
- Start the recording.

☀ How To: Your Turn

- e. If you plan to move the camera during recording, do so with slow, smooth movements.
- f. Stop the recording.

Edit a Video

- a. If you are using video editing software on your computer, transfer the video to the computer. If you are using video editing capabilities on your mobile device, run the video editing app.
- b. Make a copy of the video so that you can revert to the original if you make a mistake.
- c. Run a video editing program on your computer and open the video.
- d. To trim a video — that is, remove portions from the beginning and/or end of the video — tap or click the command to trim the video. Select the new starting and ending position for the video.
- e. To add a special effect to the video, select the location in the video where you want to add the special effect, and then tap or click the command corresponding to the special effect you want to add.
- f. To add music that will play while the video is playing, tap or click the command to add a separate audio track to the video. Next, navigate to and select the music file you want to add. Finally, select the starting and ending locations in the video for the music.
- g. Preview the video.
- h. Save your changes.
- i. Exit the video editing program.

Exercises

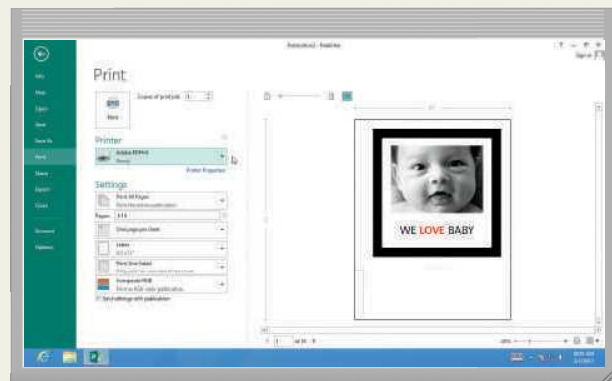
1. What reasons might you have for wanting to trim a video?
2. What type of device do you use to record videos? Why?
3. Compare and contrast at least three programs or apps that can be used to edit videos. Which one do you prefer? Why?

3 Save as or Print to a PDF File

In an effort to conserve paper, people today think twice before printing a hard copy of a document. Instead of printing a hard copy of a document, many applications have a built-in feature enabling you to print soft copies in various formats, such as PDF. You can print to a PDF file from many apps, including Microsoft Office. When you save as or print to a PDF file (both saving as or printing to PDF produce the

same results), anyone with an app capable of reading PDF files will be able to view the file without necessarily having to open it in the same program from which it was created. Several free apps you can use to view PDF files are available. The following steps guide you through the process of printing to a PDF file.

- a. Verify the app from which you want to print has a built-in feature to save files in or print files to PDF format. If this feature is not available, search for and install an app that enables you to save files to or print files in PDF format.
- b. Open the file you want to save in or print to PDF format.
- c. If you want to save the file as a PDF format, display the app's Save As dialog box and check if PDF is one of the available file types.
- d. If you want to print the file to a PDF, display the screen to print the file and select the appropriate printer to print the file to PDF.



Source: Microsoft

- e. Tap or click the button to save or print the file.
- f. Specify a file name and save location for the PDF file.

Exercises

1. What are some applications you can use to view PDF files?
2. In addition to saving paper, what are some other reasons why you might save or print to a PDF?

4 Take Screenshots

Many computer and mobile device operating systems allow you to take screenshots, which are snapshots of the screen that are saved as an image. In addition, third-party programs and apps also allow you to take screenshots. The following steps guide you through the process of taking a screenshot on your computer or mobile device.

How To: Your Turn

- If you wish to use a third-party app to take a screenshot, search for, download, and install the desired app. Next, run the app and review the required steps to take the screenshot.
- Display the desired programs, apps, or windows on the screen of which you want to take a screenshot.
- Issue the desired command to take the screenshot. On computers, you may need to press a specific key combinations (such as CTRL+PRINT SCREEN). On mobile devices, you may need to press specific buttons at the same time (such as the Home button and the Power button) or perform a specific hand gesture (such as swiping your hand across the screen).
- Locate the screenshot. If you used a third-party app, it may be displayed immediately upon taking the screenshot. If you used an operating system such as Windows or Mac OS, you may need to run another app (such as Microsoft Word) and paste the image into the document. If you took the screenshot on a mobile device, you may be able to locate the screenshot in the image gallery.

Exercises

- What are at least three reasons why you may need to take a screenshot?
- Why might you want to use a third-party program or app to take a screenshot instead of using the built-in function in your computer or device's operating system?
- If you take a screenshot of an entire screen but require information in only one window on the screen, what steps can you take to manipulate the screenshot so that it shows only the portions of the screen you desire?

5 Share a Photo or Video from Your Mobile Device with an Online Social Network

If you take a photo or record a video on your mobile device and want to share it with your friends, you might consider uploading it to an online social network. You can share a photo or video from your mobile device with an online social network in several ways, depending upon the online social network and how your mobile device is configured. This exercise describes two common ways to share a photo or video from your mobile device to an online social network.

Share Button

You may be able to share photos or videos with an online social network easily by using the Share

button. To use the Share button, you must have the online social network account to which you want to share properly configured on your mobile device. The following steps guide you through the process of sharing a photo or video from your mobile device with an online social network using the Share button.

- Locate and display the photo or video on your mobile device that you want to share with the online social network.
- Tap the Share button.
- Tap the desired online social network with which you want to share the photo or video.
- If desired, type a caption or message to share with the photo or video.
- Tap the necessary button to share the photo or video.

Uploading Photos or Videos Manually

If you are unable to share your photo or video using the Share button, you can sign in to the online social network and upload it manually. The following steps guide you through the process of sharing a photo or video on an online social network by uploading it manually to your online social network account.

- If necessary, take a photo or record a video you want to share.
- Using an app installed on your mobile device or the online social network's website, sign in to your account on the online social network on which you want to share the photo or video.
- Tap the appropriate button to post or share a photo or video.
- Navigate to and select the photo or video you want to share.
- If desired, type a caption or message to share with the photo or video.
- Tap the necessary button to share the photo or video.

Exercises

- What types of photos or videos do you share with online social networks?
- Research the potential privacy risks associated with uploading photos or videos of yourself or your family. Are you comfortable sharing photos or videos on online social networks? Why or why not?
- Why might individuals want to share photos and videos on online social networks instead of using other methods such as sending them as attachments to email messages?

Internet Research

The Internet Research exercises broaden your understanding of chapter concepts by requiring that you search for information on the web.

Discover More: Visit this chapter's premium content to **challenge yourself with additional Internet Research exercises**, which include Search Sleuth, Green Computing, Ethics in Action, You Review It, and Exploring Technology Careers.

Instructions: Use a search engine or another search tool to locate the information requested or answers to questions presented in the exercises. Describe your findings, along with the search term(s) you used and your web source(s), in the format requested by your instructor (brief report, presentation, discussion, blog post, video, or other means).

1 Making Use of the Web Health and Fitness

More than 70 percent of Internet users search online for health information, and their most commonly researched topics are specific diseases or conditions, treatments and procedures, and doctors or other health professionals. One-half of these online diagnosticians say that the information they found for themselves or someone else led them to seek medical attention.

Fitness websites and apps can provide guidance and motivation for all fitness levels and lifestyles. Expert advice is offered for designing customized workout routines, maintaining a nutritious diet, and buying equipment. Other features include downloadable MP3 workouts, videos demonstrating correct exercise techniques, and the ability to locate a virtual supportive workout buddy. Users often can set goals and then track their performance and overall progress with logs and detailed graphs.

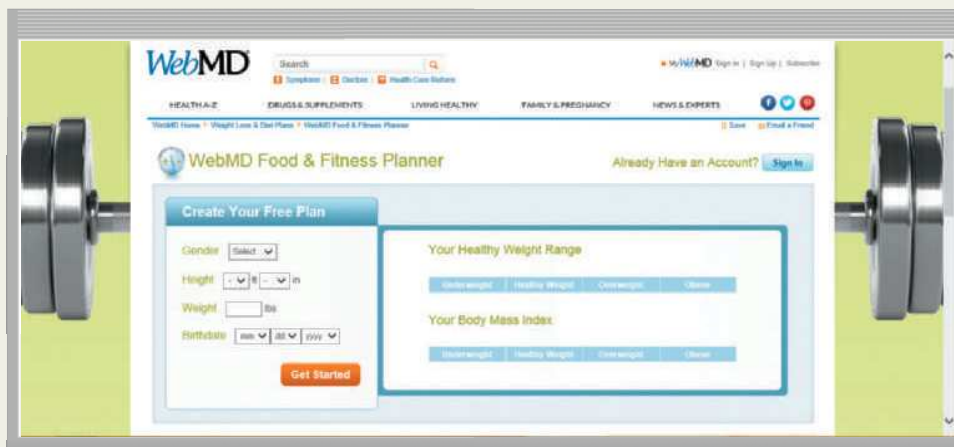
Research This: (a) Visit WebMD and two other health websites and describe the features of each. Which of the three is the most user-friendly? Why? Search for the difference between the flu and a cold. Describe the symptoms of each and the recommended foods to eat when you are suffering from either ailment.

(b) Visit WebMD and two fitness websites. What similar features do these websites have, such as fitness tools, effective exercises, and food planners? Which website is the easiest to navigate? Why? Which articles, planners, and tools would you use to start or continue your fitness routines?

2 Social Media

Aspiring musicians have turned to online social networks to break into the music business and to promote their material. Musical artists are urged to develop accounts on YouTube, Facebook, OurStage, MP3.com, Ourwave, Twitter, Myspace, Last.fm, PureVolume, and other online social networks to interact and stay connected with their fans. They can post information about concerts and album releases and sell concert tickets. They also can add music that fans can listen to, download at no charge, or purchase. Some online social networks sponsor contests for bands to showcase their talents and vie for fans' votes to play live at a local venue. Others are crowd-funding websites where bands can ask fans to pledge a specific amount of money to support the artists' creative efforts.

Research This: View at least two websites that allow listeners to recommend music and share playlists. What similarities and differences do these websites have? Locate one of your favorite artists on an online social network and describe the content displayed. For example, are concerts and new releases being promoted? Then, search for and then view at least two musician websites. What types of music are available? Which new artists and songs did you hear?

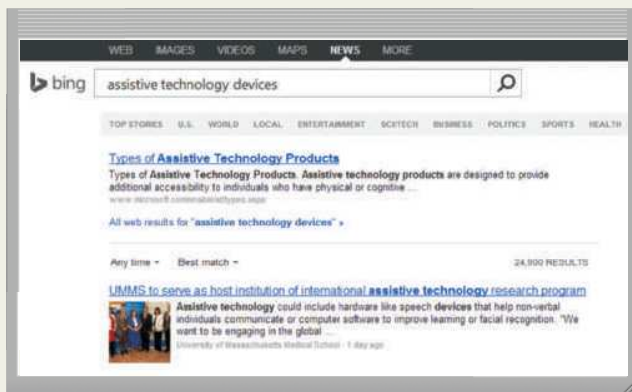


Source: WebMD

Internet Research

3 Search Skills News Search

Performing a news search using a search engine will limit search results to news stories that appeared recently or in the past in newspapers and magazines, news websites, and other electronic media news sources. To search for news articles about assistive technology devices, for example, type the search text, assistive technology devices, in the search engine's search box and then tap or click the News link on the search page. You may narrow the results by specifying a date range or location. Tap or click the search button to see the results.



Source: Microsoft

Research This: Create search text using the techniques described above or in previous Search Skills exercises, and type it into a search engine to answer these questions. Present a summary of your findings. (1) Find news articles about the enterprise uses of 3-D printing. (2) Find news articles suggesting capabilities to be included in the next iPhone. (3) Find a news story published within the past week describing how any company uses QR codes. (4) Select a technology company and then find news stories about its financial earnings during the past three months.

4 Security

The Office of Cyber and Infrastructure Analysis (OCIA), a division of the U.S. Department of Homeland Security, strives to thwart and respond to physical or cyberthreats and hazards. Part of the office's role is to implement two policies: (1) Presidential Policy Directive 21 - Critical Infrastructure Security and Resilience, and (2) Executive Order 13636 - Improving Critical Infrastructure Cybersecurity. These two policies are designed to strengthen and secure the country's critical physical assets and services, such as air traffic control, natural gas supplies, water treatment, power plants, and finance, which are likely targets of cyberattacks. Federal

agencies must comply with and routinely assess privacy standards and civil liberties protections. The government must share information regarding the cyberthreats, such as malicious code found on networks, but not contents of personal email messages. The private companies are urged to adopt the security incentives and increase their security systems, but participation is voluntary.

Research This: Locate Presidential Policy Directive 21 - Critical Infrastructure Security and Resilience and Executive Order 13636 - Improving Critical Infrastructure Cybersecurity and read their contents. Then, research news articles describing lawmakers' and businesses' support and criticism of these orders. What components are proposed to increase the nation's cybersecurity? What positions do the Internet Security Alliance and The Internet Association take on this matter? What efforts has Congress made to pass legislation addressing computer security?

5 Cloud Services Virtualization (IaaS)

An online business's website receives higher traffic during peak holiday shopping times. Purchasing and configuring additional servers to meet this demand for the short term can be an expensive task for companies managing complex computing environments. To minimize cost and maximize performance, companies often use virtualization software rather than purchasing and installing additional memory, storage, or processing power. Virtualization software allows one physical machine to emulate the capabilities of one or more servers. Virtualization is an example of infrastructure as a service (IaaS), a service of cloud computing that allows users to configure a computing environment's hardware, devices, storage, and operating systems using software. Amazon Web Services and Microsoft Azure are two cloud providers of virtualization services. (To learn more about virtualization, visit Chapter 9's free resources and read the High-Tech Talk article on this topic.)

Research This: (1) Use a search engine to find current articles, websites, or reviews of the virtualization offerings of Microsoft Azure and Amazon Web Services. (2) Find a case study about a company using Microsoft Azure or Amazon's virtualization services, summarize the problem the company was trying to solve, and describe how virtualization played a part in solving it. (3) Refer to the Chapter 6 Internet Research activity on private, public, and hybrid clouds. Why is running a private cloud in a virtualized environment a popular cloud computing solution?

Critical Thinking

The Critical Thinking exercises challenge your assessment and decision-making skills by presenting real-world situations associated with chapter concepts. The Collaboration exercise should be completed with a team.

Instructions: Evaluate the situations below, using personal experiences and one or more resources available to you (such as articles on the web or in print, blogs, podcasts, videos, television, user guides, other individuals, electronics or computer stores, etc.). Perform the tasks requested in each exercise and share your deliverables in the format requested by your instructor (brief report, presentation, discussion, blog post, video, or other means).

1. Bar Codes versus RFID

You work as an efficiency analyst at one of the largest retail companies in the world, with multiple stores in every state, as well as in many other countries. For the past 25 years, the company has used bar code readers at checkout counters that scan the bar code on products to determine from a database the price to charge customers and to keep a record of inventory. The company is considering replacing the bar codes and bar code readers with RFID.

Do This: Analyze and discuss the impact such a change would have on the company, its suppliers, and its customers. Include in your discussion any security risks. Find two examples of RFID readers and compare prices, user reviews, and features. Are handheld options for RFID readers available for store clerks to use on the store floor or for customer checkout? Compile your findings. List advantages and disadvantages of implementing RFID. Include information about reliability and costs.

2. Carpal Tunnel Syndrome

While attending college for the past two years, you have worked part-time as a data entry clerk. Recently, you began to feel a pain in your right wrist. Your doctor diagnosed the problem as carpal tunnel syndrome, which is the most well-known of a series of musculoskeletal disorders that fall under the umbrella of repetitive strain injuries (RSIs). Your doctor made several recommendations to relieve the pain. You want to learn more about this debilitating injury.

Do This: Use the web to investigate carpal tunnel syndrome. Research the carpal tunnel syndrome warning signs and risk factors. Find suggestions about proper workstation ergonomics to avoid carpal tunnel

syndrome. Evaluate the differences among various treatment options. Does insurance typically cover treatment? Include in your discussion the average length of time of recovery. How should you change your workspace to help heal and prevent further damage? Should the company's insurance pay for changes to your workspace? Why or why not?

3. Case Study

Amateur Sports League You are the new manager for a nonprofit amateur soccer league. You recently hired a part-time employee who is visually impaired. The league's board of directors has asked you to assess your current input and output devices and make recommendations for assistive technologies. The new employee will need to enter data and review on-screen and printed information to ensure accuracy and identify trends.

Do This: Use the web to find information about assistive input devices, such as voice recognition and larger keyboards. Research output devices, such as large-screen monitors and Braille printers. In addition to devices, research assistive software that you can install on existing computers and devices shared by others. Find reviews from users of these assistive devices. Research costs for implementation, and find information about any grants your company can apply for as a nonprofit to ease the costs. Compile your findings.



© Don Farrall / Getty Images

Collaboration

4. Printer Comparison You work for a local real estate agency as an IT consultant. The agency needs a new, networked printer it can use to print high-quality, custom color brochures for the homes it is showing. Each brochure is printed double-sided on glossy paper, and the agency prints an average of 200 per week.

Do This: Form a three-member team. Refer to Figure 7-26 in this chapter, which lists several questions to consider when choosing a printer, and divide the questions among your team. Each team member should answer each question according to what the employer needs. Then, each team member should use the web to research at least two printers that meet the requirements. Meet with your team, and discuss and compile your findings. Share information about the printers you researched, describe their features, and evaluate their advantages and disadvantages. Identify any additional questions you might have for the employer, such as needs for wireless printing and printing from mobile devices. Which printer you would recommend? Why?