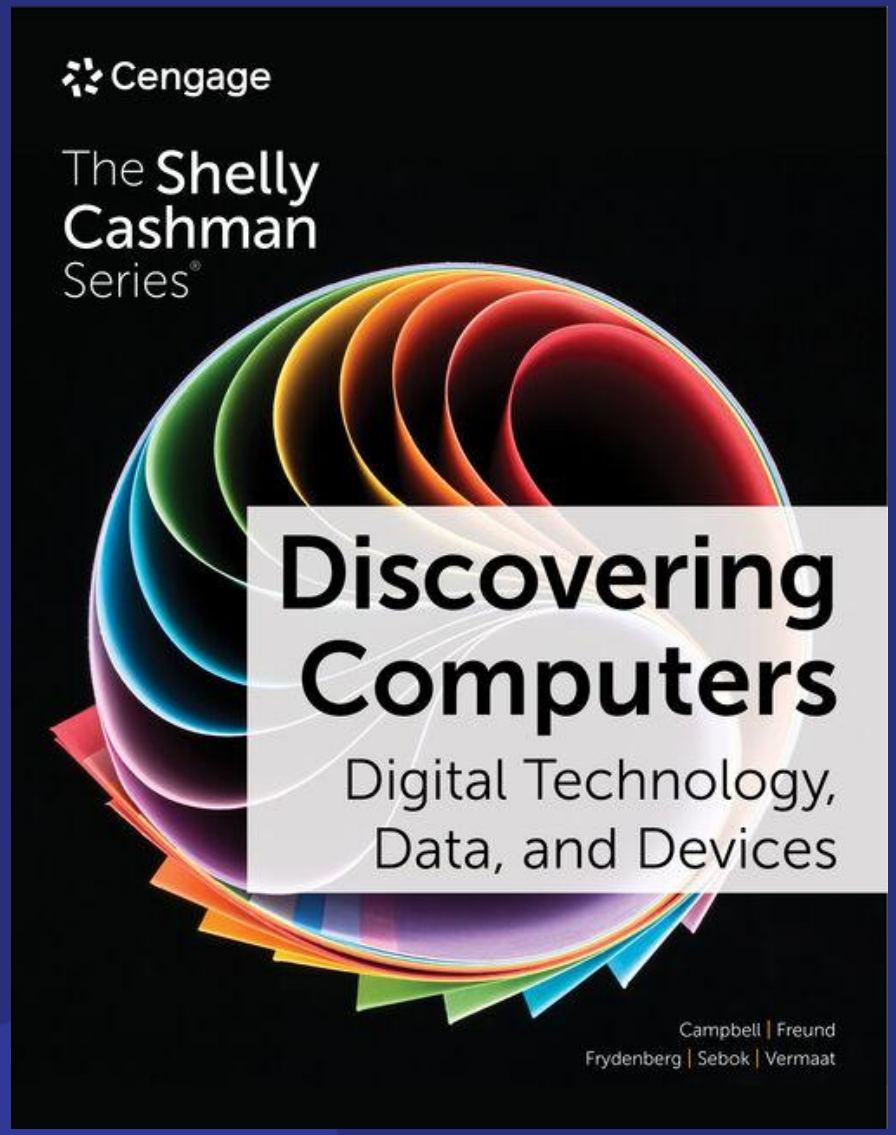

CS 110 – Introduction To Computing

Module 3: Input and Output: Entering Data and Producing Information

Module Objectives

By the end of this module, you should be able to:

- Differentiate between input and output
- Identify manual input devices
- Identify digital input devices
- Identify physical output methods
- Identify digital output methods
- Identify uses of various assistive technology input and output methods
- Explain how to customize and manage input and output devices
- Identify e-waste risks and strategies

Input and Output (1 of 2)

How Do You Use Input?

- Data is a collection of unprocessed items, including text, numbers, images, audio, and video.
- A variety of options are used to input data and instructions into a computer.
- 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.
- 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.

Figure 6-1 Examples of input devices.

Input and Output (2 of 2)

How Do You Use Output?

- Output varies in form depending on the hardware and software being used and the requirements of the user.
- Four basic types of output:
  - ✓ Text (text messages, email messages, memos, books, etc.)
  - ✓ Graphics (photos, clip art, charts, GIFs, etc.)
  - ✓ Audio (sporting events, radio, audio clips, news, music, etc.)
  - ✓ Video (movies, weather conditions, live performances, etc.)

Figure 6-2 An electronic newsletter with graphics.

Manual Input (1 of 12)

A manual input device is one in which you enter data directly into the device.

Typing and Pointing Input

- Keyboards and pointing devices are traditional types of manual input devices.
- Keyboards enable you to type text or commands.
- Pointing devices enable you to make selections on the screen.
- All keyboards have a typing area, function keys, toggle keys, and navigation keys.
- Many also include media control buttons, Internet control buttons, and other special keys.

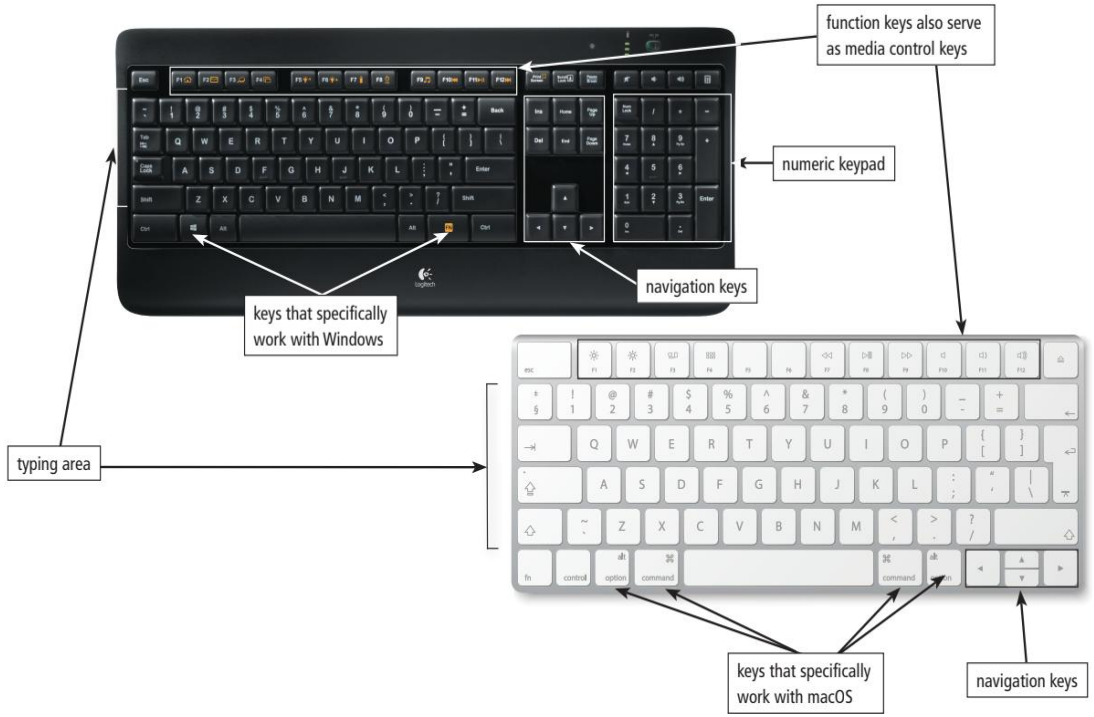

Figure 6-3 Windows and macOS standard keyboards.

Manual Input (2 of 12)

- **Function keys**, which are labeled with the letter F followed by a number, are special keys programmed to issue commands to a computer.
- A **Toggle key** is a key that will alternate views or turn a feature on or off each time you press it. Caps Lock and Num Lock are examples of toggle 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 a program or app left, right, up, or down.
- A **keyboard shortcut** is a key or combination of keys used to access a feature to perform a command.

Manual Input (3 of 12)

Using Pointing Devices

- In a **graphical user interface**, a **pointer** is a small symbol on the screen that takes different shapes depending on the task you are performing, the application you are using, and the pointer's location on the screen.
- A **pointing device** can enable you to select text, graphics, and other objects, such as buttons, icons, links, and commands.

Manual Input (4 of 12)

A **mouse** is a pointing device that fits under the palm of a hand comfortably.

- The bottom of a mouse is flat and contains a mechanism that detects the movement of the mouse
- An **optical mouse** uses optical sensors
- A **touch mouse** is a touch-sensitive mouse that recognizes touch
- A **laser mouse** uses laser sensors
- An **ergonomic mouse** helps reduce the pain and discomfort associated with RSIs

Figure 6-6 Laser mouse.

Manual Input (5 of 12)

- A **touchpad** is a small, flat, rectangular pointing device that is sensitive to pressure and motion.
- Touchpads are found most often on laptops and convertible tablets.
- Some touchpads also recognize touch gestures, such as swipes, pinches, and stretching motions.

Figure 6-7 Touchpad.

Manual Input (6 of 12)

- **Finger input:** Use a touch screen by touching areas of the screen with your finger or a stylus to make selections or to begin typing.
- A **gesture** is a motion you make on a touch screen with the tip of one or more fingers or your hand.

Table 6-1 Touch screen gestures.

Motion	Description	Common Uses
Tap 	Quickly touch and release one finger one time	Activate a link (built-in connection) Press a button Run a program or app
Double Tap 	Quickly touch and release one finger two times	Run a program or app Zoom in (show a smaller area on the screen, so that contents appear larger) at the location of the double-tap
Press and hold 	Press and hold one finger to cause an action to occur, or until an action occurs	Display a shortcut menu (immediate access to allowable actions) Activate a mode enabling you to move an item with one finger to a new location

Manual Input (7 of 12)

Table 6-1 Touch screen gestures (continued).

Motion	Description	Common Uses
Drag, or slide 	Press and hold one finger on an object and then move the finger to the new location	Move an item around the screen Scroll
Swipe 	Press and hold one finger and then move the finger horizontally or vertically on the screen	Scroll Display a bar that contains commands on an edge of the screen
Stretch 	Move two fingers apart	Zoom in (show a smaller area on the screen, so that contents appear larger)
Pinch 	Move two fingers together	Zoom out (show a larger area on the screen, so that contents appear smaller)

Manual Input (8 of 12)

Monitors and Screens:

- 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 on an object on the screen, users simply can tap or double-tap the item.
- Users can tap or double-tap an icon to start a program or an application.
- Slide their finger to scroll.
- Use their finger to drag items across the screen.

Devices that utilize **touch input** include:

- ✓ Monitors and screens for computers, tablets, and smartphones
- ✓ Wearable devices & portable media players
- ✓ Digital cameras, kiosks, and navigation systems

Manual Input (9 of 12)

- **Wearable devices**, such as smart watches, do not have room for a physical keyboard, so they mainly rely on touch input.
- **Portable media players** widely use touch as the primary method of input so that the size of the screen on the device is maximized.
- Touch input helps **digital camera users** perform gestures such as swiping left and right on the screen to browse photos, tapping the screen, tapping areas of photos to remove red-eye, adding a filter, and dragging borders of photos to crop them.

Figure 6-9 Using a touch screen on a wearable device.

Manual Input (10 of 12)

- **Navigation systems** allow users to perform actions such as tapping, dragging or pinching, and stretching to zoom.
- Some navigation and other in-vehicle systems enable **voice input** as well. To reduce the chances of driver distraction, some built-in navigation systems reduce functionality while the vehicle is in **motion**.

Figure 6-10 In-car navigation system.

Manual Input (11 of 12)

- With **pen input**, you touch a stylus or digital pen on a flat surface to write, draw, or make selections.
- **Pen input devices** can be used to input information on a screen.
- A **stylus** is a small metal or plastic device that looks like a tiny ink pen but uses pressure instead of ink.
- Some stylus designs include buttons you can press to simulate clicking a mouse.
- A **digital pen** captures and converts a user's handwriting or drawings into a digital format.
- Once uploaded, **handwriting recognition software** translates the handwritten letters and symbols created on the screen into typed text or objects.

Manual Input (12 of 12)

Signature Capture Pad

- To capture a **handwritten** signature, a user writes their 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.

Figure 6-11 Customer signing at point-of-sale terminal.

- A **graphics tablet**, also called a digitizer, is a hardware device used to create drawings with a pressure-sensitive pen using an electronic plastic board that detects and converts movements of the stylus or digital pen into digital signals that are sent to the computer.

Figure 6-12 Graphics tablet.

Digital Input (1 of 12)

- **Voice input** is the process of entering input by speaking into a **microphone**. The microphone may be built into the computer or device or an external peripheral device.
- A **Voice recognition app** allows users to dictate text and enter instructions by speaking into a microphone.
- Some mobile devices have a **speech-to-text feature** that recognizes a user's spoken words and enters them into email messages, text messages, or other applications that support typed text entry.

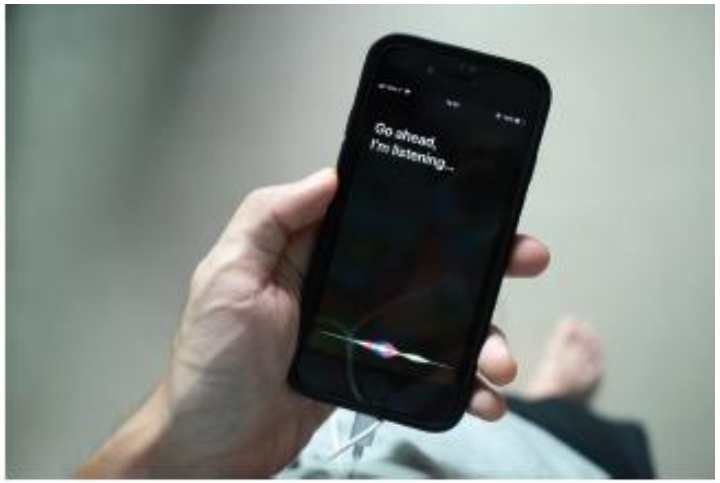

Figure 6-13 Siri, Apple's voice recognition application.

Digital Input (2 of 12)

- **Audio input** encompasses entering any sound into the computer, such as speech, music, and sound effects. To enter high-quality sound into a computer, the computer requires a sound card or integrated sound capability.
- Music production software allows users to record, compose, mix, and edit music and sounds.

Figure 6-14 Using sound mixing software to edit audio.

Digital Input (3 of 12)

- **Video input** involves capturing full-motion images and storing them on a computer or mobile device's storage medium or in the cloud.
- 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.
- A webcam is a type of digital video camera that enables you to capture video and still images, and usually audio input, for viewing or manipulation on a computer or mobile device.

The following steps are involved in the process of using DV technology:

- Step 1: Select a DV camera.
- Step 2: Record a video.
- Step 3: Transfer and manage videos.
- Step 4: Edit a video.
- Step 5: Enhance a video.
- Step 6: Distribute a video.

Digital Input (4 of 12)

- Special effects include warping, changing from color to black and white, morphing, or zoom motion. **Morphing** transforms one video image into another image throughout several frames of video.
- With **motion input or 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.
- **Motion-sensing devices** communicate with a game console using wired or wireless technology and translate a player's gestures, facial movements, and full-body motion into the input.

Figure 6-15 Using video editing software.

Digital Input (5 of 12)

Motion Input in Entertainment

- **Motion-sensing game** controllers enable a user to guide on-screen elements by moving a handheld input device through the air.
- Handheld devices enable gamers to use sweeping arm movements to simulate sports activities, such as a golf swing, balance boards, and yoga poses.

Motion Input in the Medical Field

- **The medical field** also uses motion input for training.
- Using motion input that enhances movements, surgeons also can operate less invasively.

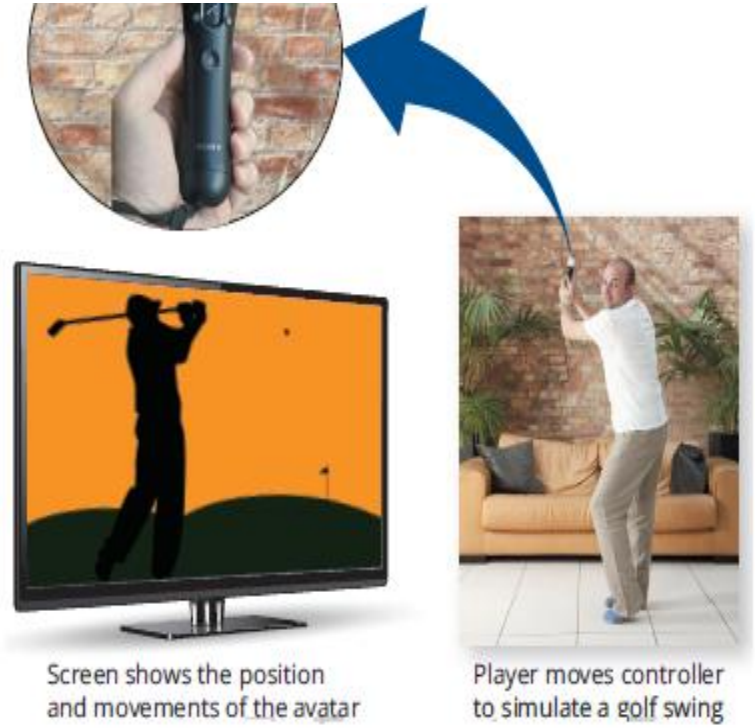

Figure 6-16 Using a motion-sensing game controller.

Digital Input (6 of 12)

Motion Input in the Military

- The military uses **motion input** for training, such as flight simulation or weapon usage.
- Motion input also aids in physical rehabilitation for wounded soldiers.
- Another use of motion input is to assist in recovery from post-traumatic stress disorder (PTSD).

Motion Input in Sports

- **Coaches and sports trainers** use motion input to improve athletes' performance and to correct inefficient or injury-causing motions.
- Combining the athlete's motion input with complex algorithms can pinpoint areas in which the athlete can improve.

Digital Input (7 of 12)

Scanners and Reading Devices

- **NFC (near-field communication)** is a close-distance network protocol used by smartphones and other devices to read data from another device or an item, such as a credit card or ticket.
- NFC enables the contactless transfer of data by enabling an app to read an electronic tag.

Figure 6-17 Using NFC to make a payment.

Digital Input (8 of 12)

- 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.
- 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.
- 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)** devices read printed characters in a special font.
  - ✓ Optical mark recognition **(OMR)** devices read hand-drawn marks, such as small circles or rectangles.

Digital Input (9 of 12)

- A **bar code reader**, also called a bar code scanner, is an optical reader that uses laser beams to read bar codes.
- A **bar code** is an identification code that often consists of either a set of vertical lines and spaces of different widths or a two-dimensional pattern of dots, squares, and other images.
- A **QR code (quick response code),** or a **2-D bar code,** stores information in both a vertical and horizontal direction in a square-shaped graphic that represents a web address or other content.

Figure 6-18 Using a QR code to access information.

Digital Input (10 of 12)

- **RFID (radio frequency identification)** is a technology that uses radio signals to communicate with a tag placed on or attached to an object, an animal, or a person.
- An RFID reader reads information on the tag via radio waves.
- RFID readers can be handheld devices or mounted on a stationary object, such as a doorway.

Figure 6-19 Using an RFID electronic key system.

Digital Input (11 of 12)

- A **magstripe reader,** short for a magnetic stripe card reader, reads the magnetic stripe on the back of credit cards, entertainment cards, bank cards, identification cards, and other similar cards.
- The **stripe** contains information identifying the owner of the card and the card issuer.
- As **chip-and-pin** technology becomes more prevalent, magstripe readers are used less widely.
- When a credit card is swiped through a **magstripe reader**, it reads the information stored on the magnetic stripe.
- **MICR (magnetic-ink character recognition)** device reads text printed with magnetized ink. MICR reader converts MICR characters into a form the computer can process.
- The banking industry almost exclusively uses MICR for check processing.
- Each check that is inserted in the MICR reader sends the check information—including the amount of the check—to a computer for processing.

Digital Input (12 of 12)

- A **data collection device** obtains data directly at the location where the transaction or event takes place.
- 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.
- **Data collection devices** have the capability of wirelessly transmitting data over a network or the Internet.

Figure 6-20 Using a data collection device in a warehouse.

Physical Output (1 of 9)

- 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:
  - ✓ **Portrait orientation** (taller, information is on the shorter width) or
  - ✓ **Landscape orientation** (wider, information is on the widest part).
- Letters, reports, and books typically use portrait orientation.
- Spreadsheets, slide shows, and graphics often use landscape orientation.

Physical Output (2 of 9)

- **A non-impact 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 **non-impact printers** are:
  - ✓ inkjet printers
  - ✓ photo printers
  - ✓ laser printers
  - ✓ all-in-one printers
  - ✓ 3-D printers
  - ✓ Thermal printers
  - ✓ mobile printers
  - ✓ label printers
  - ✓ plotters
  - ✓ large-format printers

Physical Output (3 of 9)

- An **inkjet printer** is a type of non-impact printer that forms characters and graphics by spraying tiny drops of liquid ink onto a piece of paper.
- Inkjet printers produce text and graphics in both black-and-white and color on a variety of paper types and sizes.
- The print head mechanism in an inkjet printer contains ink-filled cartridges.
- Each cartridge has 50 to several hundred small ink holes, or nozzles.

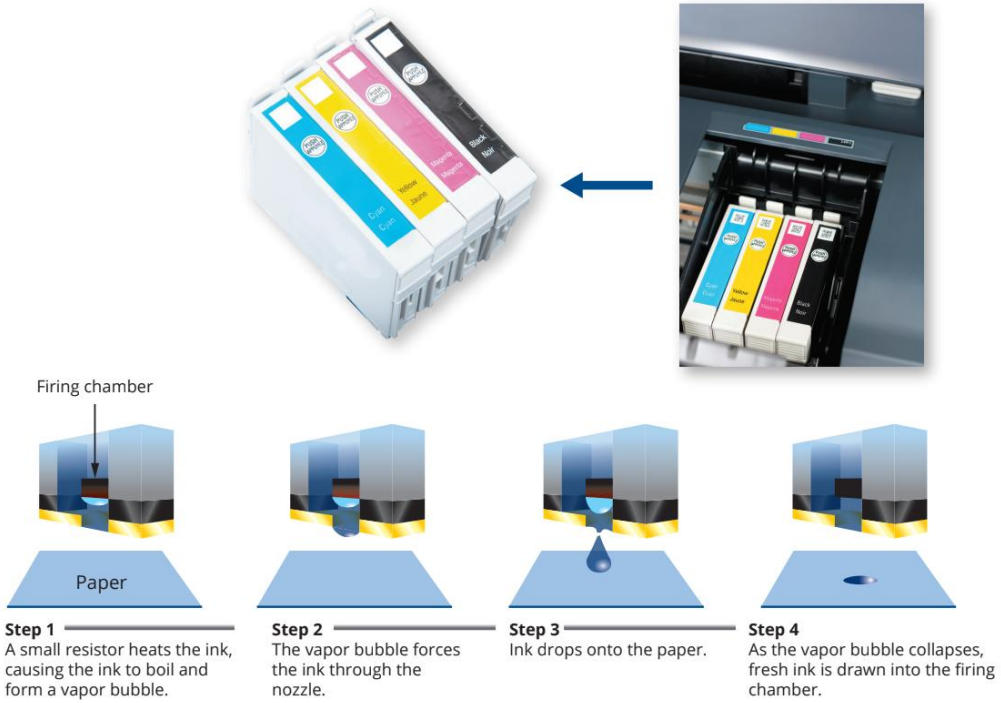

Figure 6-22 How an inkjet printer works.

Physical Output (4 of 9)

- A **photo printer** is a color printer that produces lab-quality photos.
- Many photo printers use inkjet 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.

Figure 6-23 Photo printer.

Physical Output (5 of 9)

- A **laser printer** is a high-speed, high-quality non-impact printer. Laser printers are available in both black-and-white and color models.
- Laser printers print text and graphics in high-quality resolutions.
- When printing a document, laser printers process and store the entire page before printing.
- 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.

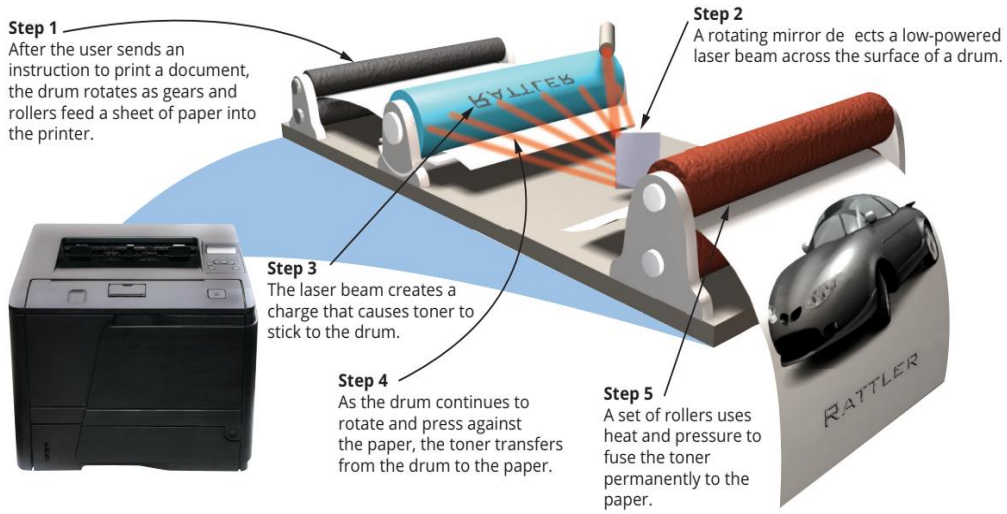

Figure 6-24 How a laser printer works.

Physical Output (6 of 9)

- 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, and copy machine.
- 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, and prototypes.

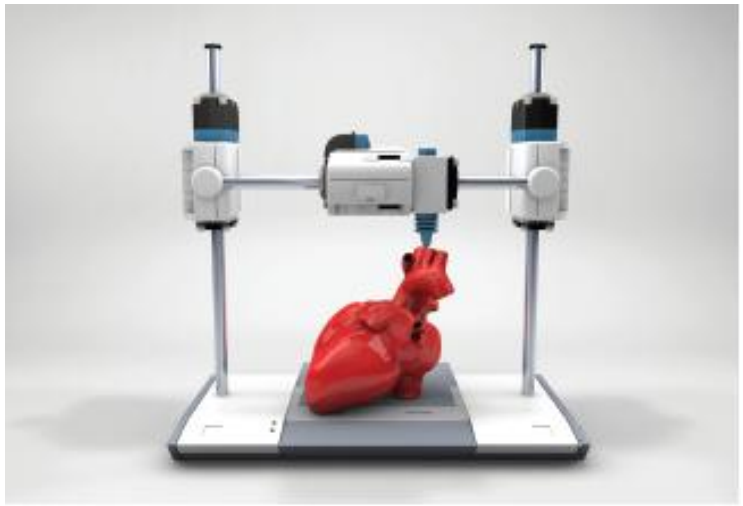

Figure 6-25 3-D printer creating a model of a heart.

Physical Output (7 of 9)

- A **thermal printer** generates images by pushing electrically heated pins against heat-sensitive paper.
- Some thermal printers have high print quality.
- A dye-sublimation printer, sometimes called a digital photo printer, uses heat to transfer colored dye to specially coated paper.
- A **mobile printer** is a small, lightweight, battery-powered printer that allows a mobile user to print from a laptop, smartphone, or other mobile devices while traveling.
- Mobile printers mainly use inkjet or thermal technology.

Physical Output (8 of 9)

- A **plotter** is a sophisticated printer used to produce high-quality drawings, such as blueprints, maps, and circuit diagrams.
- 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.
- 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 6-27 Large format printer.

Physical Output (9 of 9)

- 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.
- Most label printers also print bar codes.
- 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.
- Impact printers are ideal for printing multipart forms.

Digital Output (1 of 9)

- A **display device**, or simply a display, is an output device that visually conveys text, graphics, and video information.
- **Soft copy** is information on a display that exists electronically and appears for a temporary period.
- Desktops often use a monitor as their display.
- Adjustable monitor stands allow you to adjust the height of the monitor to be at eye level.
- Many users set up multiple monitors to display separate screens of information from the same computer or device.

Figure 6-29 Using two monitors.

Digital Output (2 of 9)

- An **LCD (liquid crystal display)** 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.
- A display that uses an LED for the backlight is often called an LED display. **LED** displays consume **less power**, **last longer**, and are **thinner**, **lighter**, and **brighter.**
- Some displays use **OLED** technology which includes organic molecules that are self-illuminating and, thus, do not require a backlight.
- OLEDs can also be fabricated on thin, flexible surfaces.
- An **AMOLED** (active-matrix OLED) screen uses both active-matrix, that is, a high-quality, lightweight display technology capable of producing a wide range of colors with a fast response time.

Digital Output (3 of 9)

Display Quality

The screen on a monitor, laptop, tablet, smartphone, or other mobile device is measured diagonally from one corner to the other.

Resolution

- Displays are optimized for a specific resolution, called the native resolution.
- A higher resolution uses a greater number of pixels and provides a smoother, sharper, and clearer image.
- As the resolution increases, some items on the screen appear smaller.

Response Time

The **response time** of a display refers to the time in milliseconds (ms) that it takes to turn a pixel on or off. The lower the number, the faster the response time.

Digital Output (4 of 9)

Brightness

- **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.

Dot Pitch

- **Dot pitch,** or **pixel pitch,** is the distance in millimeters between pixels on a display.
- Text created with a smaller dot pitch is easier to read. The lower the number, the sharper the image.

Contrast Ratio

- **Contrast ratio** describes the difference in light intensity between the brightest white and the darkest black that can be produced on a display.

Digital Output (5 of 9)

- A graphics chip, called the **graphics processing unit** (**GPU)**, controls the manipulation and display of graphics on a display device.
- The GPU is either integrated on the motherboard or resides on a video card in a slot on the motherboard.
- Several video standards define the resolution, aspect ratio, number of colors, and other display properties.
- The **aspect ratio** defines a display's width relative to its height.
- **HDTV (high-definition television)** works with digital broadcast signals, transmitting digital sound, supporting wide screens, and providing high resolutions.

Digital Output (6 of 9)

HDTVs and Smart TVs

- 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.
- A **plasma display** uses gas plasma technology, which sandwiches a layer of gas between two glass plates.
- **UHD (ultra-high-definition)** television expands on HDTV technology to provide even better resolution.

Figure 6-30 Using a Smart TV.

Digital Output (7 of 9)

- Most personal computers and mobile devices have a small internal speaker that usually emits only low-quality sound.
- Many users attach **surround sound speakers or speaker systems** to their devices to generate higher quality sounds.
- **Users** can listen through headphones or earbuds so that only the individual wearing the headphones or earbuds hears the sound from the computer.
- Both headphones and earbuds usually include noise-canceling technology.
- A headset functions as both headphones and a microphone.

Figure 6-31 Computer speakers.

Digital Output (8 of 9)

- A **data projector** is a device that projects the text and images displayed on a computer or mobile device screen onto a larger screen so that an audience can see the image clearly.
- Many classrooms use **data projectors** so that all students can easily see an instructor's presentation on the screen.
- 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.

Figure 6-32 Interactive whiteboard.

Digital Output (9 of 9)

Gaming and Motion-Sensing Devices

- Joysticks, wheels, gamepads, and motion-sensing game controllers are used to control the 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.**

Figure 6-33 Gaming wheel.

Ethics and Issues: Assistive Technology Input and Output (1 of 2)

- The goal of accessible input and output is to enable all users to be independent when working with, being entertained by, or accessing services that use technology.
- **Adaptive Input Devices** for blind, visually impaired users, limited hand mobility, deaf users, and so on include the following:
  - ✓ **Eye gaze pointing devices** analyze the area of the screen that the user is looking at.
  - ✓ A **foot mouse** enables users with limited mobility in their arms or hands to control input using their feet.
  - ✓ **Sip-and-puff (SNP) technology** enables users to control the mouse or other computer or device functions using a tube that they either inhale (sip) or exhale (puff) to issue commands.

Ethics and Issues: Assistive Technology Input and Output (2 of 2)

Adaptive Output Devices include the following:

- **Refreshable Braille displays** use nylon pins or magnets to translate content into the Braille system so that users can read it with their fingers.
- Braille printers use embossing techniques to produce hard copies of digital content that can be read by touch.
- OCR readers can scan printed materials and digitize them so that a screen reader can read the content aloud or print it on a Braille printer.

Figure 6-34 Refreshable Braille display.

How To: Customize and Manage Input and Output Devices (1 of 2)

- When you start using a computer or device, the operating system and related software and hardware have default settings.
- **Default settings** are standard settings that control how the screen is set up and how a document looks when you first start typing.
- Everyone customizes the settings to be more productive. **Customize System Software** includes:
  - ✓ Changing the brightness of the screen
  - ✓ Adding a desktop theme
  - ✓ Adjusting the screen resolution
  - ✓ Adding a sound scheme
  - ✓ Pinning frequently used apps to the taskbar for easy access

How To: Customize and Manage Input and Output Devices (2 of 2)

Customize Input and Output Devices Using System Software

- Controlling the pointing device with the keyboard by using the arrow and other keys
- Changing the language or dialect associated with the keyboard
- Creating new keyboard shortcuts to commands
- Adjusting the settings for toggle keys

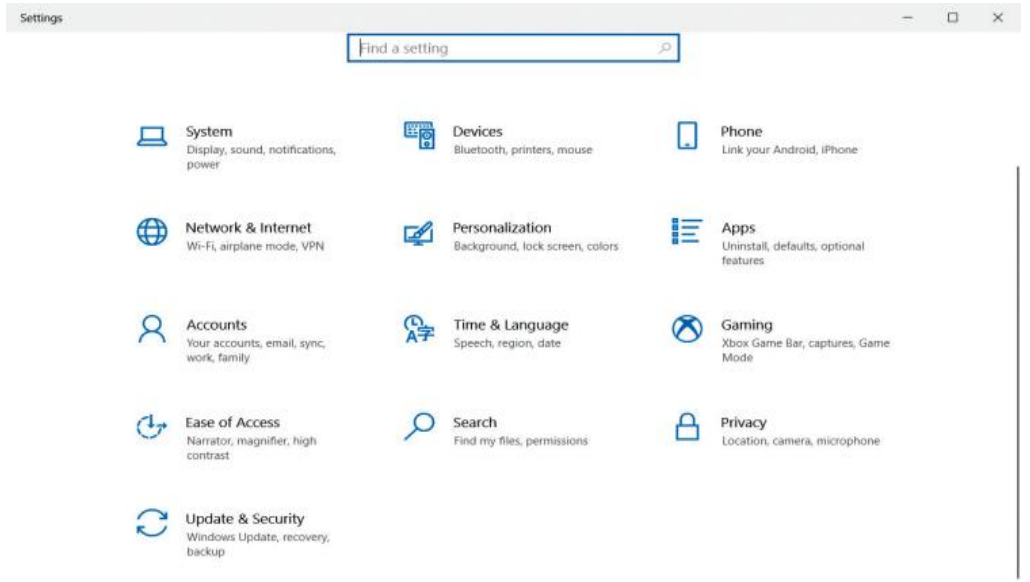

Figure 6-35 The Windows Settings dialog box.

Secure IT: Reduce E-Waste Risks (1 of 2)

- Every electronic device emits some level of radiation.
- The amounts for computers and mobile devices may not be harmful in low doses.

Suggestions to Help Protect Yourself and Minimize Risks:

- Replace older equipment, such as CRT (cathode-ray tube) monitors, with devices such as LCD monitors
- Sit back from your monitor as far as possible
- While using the device while sitting, protect your lap with a device that shields you from radiation
- Move other electronic sources, such as hard drives and printers, as far away as possible

Secure IT: Reduce E-Waste Risks (2 of 2)

Suggestions to Help Protect Yourself and Minimize Risks:

- Minimize your wireless connections, such as a wireless keyboard or a wireless mouse
- Remove your Bluetooth headset when not in use
- 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
- Take regular breaks from technology use