Chapter 6 Objectives

- Define the four categories of output
- Identify the different types of display devices
- Describe factors that affect the quality of a monitor
- Identify monitor ergonomic issues
- Explain the differences among various types of printers
- Describe the uses of speakers and headsets
- Identify the purpose of data projectors, fax machines, and multifunction devices
- Explain how a terminal is both an input and output device
- Identify output options for physically challenged users

What is Output?

What is output?
- Data that has been processed into a useful form, called information
- A computer generates several types of output

What is text?
- Consists of characters that create words, sentences, and paragraphs

What is audio?
- Music, speech, or any other sound

What is video?
- Consists of full-motion images that are played back a various speeds
- Most video also has accompanying audio

What is a graphic?
- Also called a graphical image
- A digital representation of non-text information such as a drawing, chart, and photograph

What are Output Devices?

What is an output device?
- Any hardware component that can convey information to a user
Display Devices

What is a display device?
- Also called a display
- An output device that visually conveys text, graphics, and video information
- Information on a display device is sometimes called soft copy

What are the parts of a display device?
- The screen, or projection surface
- Components that produce the information on the screen

What are typical sizes for CRT monitors?
- 15, 17, 19, 21, and 22 inches
- Monitor measured diagonally from one corner of the casing to the other
- The viewable size is the diagonal measurement of the actual viewing area provided by the monitor

What is a CRT monitor?
- Contains a cathode ray tube (CRT), a large sealed, glass screen
- The screen is coated with tiny dots of phosphor material
- A pixel, or picture element, is a single point in an electronic image
- Three dots (red, blue, and green) combine to make up each pixel

What is a liquid crystal display (LCD) monitor?
- A type of flat-panel display
- Uses liquid crystals between two sheets of material to present information on a screen
- An electric current passes through the crystals which creates the images on the screen

In what ways is information displayed on a screen?
- Most display devices project information in color
- Monochrome means that the information displays in one color on a different color background
- Monochrome monitors may use gray scaling, which involves using many shades of gray from white to black to provide better contrast

A monitor is a separate plastic or metal case that houses the screen
Most mobile computers integrate the display and other components into the same physical case

Contains a cathode ray tube (CRT), a large sealed, glass screen
The screen is coated with tiny dots of phosphor material
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A liquid crystal display (LCD) monitor
A cathode ray tube
The screen is coated with tiny dots of phosphor material
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### Display Devices

**Where are some features of LCD screens?**
- Lightweight and compact
- Consumes less than one-third of the power than does a CRT monitor
- Come in a variety of sizes
- Ideal for notebook and handheld computers

**What is a Web-enabled device?**
- A device that allows access to the Web or e-mail such as cellular telephones and pagers
- Uses an LCD display
- Many use monochrome displays to save battery power

**What is an electronic book (e-book)?**
- A small, book-sized computer that uses an LCD screen
- Allows users to read, save, highlight, bookmark, and add notes to online text
- ClearType, a new technology developed by Microsoft, used to improve the quality of reading material on LCD screens

**What are the two technologies used for LCD monitors?**

- **passive-matrix display**
  - Also called a dual-scan display
  - Uses fewer transistors and requires less power than an active-matrix display
  - Color often not as bright and images are best viewed when working directly in front of the display

- **active-matrix display**
  - Also known as a thin-film transistor (TFT) display
  - Uses a separate transistor for each color pixel
  - Can display high-quality color that is viewable from all angles

**What is a gas plasma monitor?**
- A flat-panel display that uses gas plasma technology
- A layer of gas between two sheets of material
- When voltage is applied, the gas releases ultraviolet (UV) light that causes the pixels on the screen to glow and form an image
- Larger screen sizes and higher display quality than LCD, but much more expensive

### Company on the Cutting Edge

**Motorola**
- Created by Paul and Joseph Galvin in 1928 to make car radios
- Originally known as the Galvin Manufacturing Corporation
- Renamed Motorola, combining the ideas of motion and radio
- Now a formidable leader in wireless communication
What is display resolution?
- Describes the sharpness and clearness of an image
- Resolution of a display device stated as dots, or pixels
  - 800 x 600 typically the standard
  - 1280 x 1024 maximum resolution of most monitors
  - 2048 x 1536 maximum for high-end monitors

What is dot pitch?
- Another factor used to measure image clarity
- Sometimes called pixel pitch
- The distance between each pixel on a display
- The smaller the distance between the pixels, the sharper the image
  - Use a monitor with a dot pitch of .29 millimeters or lower to minimize eye fatigue

What is a video card?
- Converts digital output from the computer into an analog video signal
- Sends the signal through a cable to the monitor
- Controls how the display device produces the picture
- Also called a graphics card or video adapter

What is refresh rate?
- Another factor in a monitor’s quality
- Also called vertical frequency or vertical scan rate
- The speed that a monitor redraws images on the screen
- Measured according to hertz, which is the number of times per second the screen is redrawn
  - Should be fast enough to maintain a constant, flicker-free image
  - A high-quality monitor will provide a refresh rate of at least 75 hertz
  - The image on the screen redraws itself 75 times in a second

How does video travel from the processor to a CRT monitor?
Step 1: The processor sends digital video data to the video card.
Step 2: The video card’s digital-to-analog converter (DAC) sends the analog video data through a cable to the CRT monitor.
Step 3: The CRT monitor separates the analog signal into red, green, and blue signals.
Step 4: Electron guns fire the three color signals to the front of the CRT.
Step 5: An image displays on the screen when the electrons hit phosphor dots on the back of the screen.
What standards exist for video cards?
- The Digital Display Working Group (DDWG) is developing a standard interface for all displays.
- The Digital Video Interface (DVI) is a new digital interface that provides connections for both CRT and LCD monitors.

What are various video standards?
- The Video Electronics Standards Association (VESA) develops video standards.

What is bit depth?
- The number of bits a video card uses to store information about each pixel.
- Also called the color depth.
- Determines the number of colors a video card can display.
- The greater the number of bits, the better the resulting image.

What are various video card configurations?

What features of monitors address ergonomic issues?
- The goal of ergonomics is to incorporate comfort, efficiency, and safety into the design of items in the workplace.
- tilt-and-swivel base adjusts the angle of the screen to minimize neck strain and reduce glare from overhead lighting.
- controls adjust the brightness, contrast, positioning, height, and width of images.

What is needed for a monitor to display images defined by a video standard?
- The video card must be capable of communicating appropriate signals to the monitor.
- The video card must have enough memory to generate the resolution and number of colors you want to display.
- Both the video card and the monitor must support the video standard to generate the desired resolution and number of colors.

What is a 24-bit video card?
- Uses 24 bits to store information about each pixel.
- Can display 16.7 million colors.

What is a 8-bit video card?
- Uses 8 bits to store information about each pixel.
- Can display 256 different colors.

- The greater the number of bits, the better the resulting image.

24-bit video card
- Uses 24 bits to store information about each pixel.
- Can display 16.7 million colors.

8-bit video card
- Uses 8 bits to store information about each pixel.
- Can display 256 different colors.

- The greater the number of bits, the better the resulting image.

2^8 = 256 colors

24^3 = 16.7 million colors
Display Devices

What is electromagnetic radiation (EMR)?
- A magnetic field that travels at the speed of light
- A small amount is produced by all CRT monitors
- All high-quality CRT monitors comply with MPR II standards
- LCD monitors do not pose this risk
- EMR is greatest on the sides and back of the CRT monitor

Sit at arm’s length from the CRT

Display Devices

How can television sets be used as monitors?
- An NTSC converter is used to convert the digital signal from the computer into an analog signal that the television set can display
- High-definition television (HDTV) is a type of television set that works with digital broadcasting signals
  - Supports a wider screen and higher resolution display than a standard television set
  - Can be used as a computer display device

Display Devices

What is the ENERGY STAR program?
- Program to encourage manufacturers to create energy-efficient devices that require little power when they are not in use
- Developed by the United States Department of Energy (DOE) and the United States Environmental Protection Agency (EPA)
- Monitors and devices meeting guidelines display an ENERGY STAR® label

Display Devices

What is Interactive TV?
- A two-way communications technology in which users interact with television programming
- HDTV works directly with interactive TV
  - Select a movie from a central library of movies
  - Bank
  - Shop
  - Play games
  - Vote or respond to network questionnaires

Printers

What is a printer?
- An output device that produces text and graphics on a physical medium such as paper or transparency film
- A hard copy, or printout, exists physically
- Two orientations

Printers

What is Internet printing?
- An Internet service on the Web sends a print instruction to your printer
- Printer may be at a different location than your computer or the device that accessed the Web site
What is an impact printer?
- Forms characters and graphics on a piece of paper by striking a mechanism against an ink ribbon that physically contacts the paper
- Generally are noisy because of this striking activity
- Ideal for printing multipart forms because they easily can print through many layers of paper
- Can withstand dusty environments, vibrations, and extreme temperatures

What are the levels of quality produced by an impact printer?
- Impact printers typically do not provide letter quality print
- Letter quality (LQ) output is a quality of print acceptable for business letters
- Near letter quality (NLQ) is slightly less clear than letter quality
- Used for routine jobs

What is a dot-matrix printer?
- An impact printer that produces printed images when tiny wire pins on a print head mechanism strike an inked ribbon
- Most use continuous-form paper, in which each sheet of paper is connected together
- The pages have holes along the sides to help feed the paper through the printer

How does a dot-matrix printer work?
- When the ribbon presses against the paper, it creates dots that form characters and graphics
- The print head mechanism can contain 9 to 24 pins
- A higher number of pins means the printer prints more dots per character, which results in higher print quality

What is a line printer?
- A high-speed impact printer that prints an entire line at a time
- The speed is measured by the number of lines per minute (lpm) it can print

What are the two types of line printers?
- Band printer prints fully-formed characters when hammers strike a horizontal, rotating band that contains shapes of numbers, letters of the alphabet, and other characters
- A shuttle-matrix printer moves a series of print hammers back and forth horizontally
  - Works more like a dot-matrix printer
What is a non-impact printer?
- Forms characters and graphics on a piece of paper without actually striking the paper.
- Three common types: ink-jet printers, laser printers, thermal printers.

What is an ink-jet printer?
- A type of nonimpact printer that forms characters and graphics by spraying tiny drops of liquid ink onto a piece of paper.
- Usually uses individual sheets of paper stored in a removable or stationary tray.
- The most popular type of color printer for use in the home.

What is the resolution of a printer?
- Also called sharpness and clarity.
- Measured by the number of dots per inch (dpi) a printer can output.

What is a print cartridge?
- The print head mechanism contains an ink-filled print cartridge.
- Each cartridge has fifty to several hundred small ink holes, or nozzles.
- Cartridges usually cost from $20 to $40 per cartridge.

How does an ink-jet printer work?
1. A small resistor heats the ink, causing the ink to boil and form a vapor bubble.
2. The vapor bubble forces the ink through the nozzle.
3. Ink drops onto the paper.
4. As the vapor bubble collapses, fresh ink is drawn into the firing chamber.

What is a laser printer?
- A high-speed, high-quality nonimpact printer.
- Usually use individual sheet of paper stored in a removable tray.
- Can print text and graphics in very high quality resolution, ranging from 600 to 1,200 dpi.
- Typically costs more than ink-jet printers, but are much faster.
Printers

How does a laser printer operate?
- Operates in a manner similar to a copy machine
- Creates images using a laser beam and powdered ink, called toner
- When toner runs out, you can replace the toner cartridge
- Toner cartridge prices range from $50 to $100 for about 5,000 printed pages

How does a laser printer work?
Step 1: The drum rotates as gears and rollers feed a sheet of paper into the printer.
Step 2: A rotating mirror deflects a low-powered laser beam across the surface of a drum.
Step 3: The laser beam creates a charge that causes toner to stick to the drum.
Step 4: As the drum continues to rotate and press against the paper, the toner transfers from the drum to the paper.
Step 5: A set of rollers uses heat and pressure to fuse the toner permanently to the paper.

What is a page description language?
- A page description language (PDL) tells the printer how to layout the contents of a printed page
- Laser printers use a PDL to process and store the entire page before they actually print it so they are sometimes called page printers
- Laser printers require a certain amount of memory in the device to store a page before printing
- PCL (Printer Control Language) Developed by Hewlett-Packard
- A standard printer language that supports the fonts and layout used in standard office documents
- PostScript
- Designed for complex documents with intense graphics and colors
- Used by professionals in the desktop publishing and graphic art fields

What is 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 and the images tend to fade over time
- Thermal wax-transfer printer
  - Also called a thermal transfer printer
  - Generates rich, nonsmearing images by using heat to melt colored wax onto heat-sensitive paper

What is a dye-sublimation printer?
- A type of thermal printer
- Also called a thermal dye transfer printer
- Uses heat to transfer colored dye to specially coated paper
- Cost several thousand dollars
- Can create images that are of photographic quality

Company on the Cutting Edge
Hewlett-Packard
- Bill Hewlett and Dave Packard began the business in their garage more than 60 years ago
- Created the first set of corporate objectives in 1957, known as the HP Way
- Today noted for a range of high-quality products, including personal computers, notebook computers, scanners, and ink-jet and laser printers

Thermal wax-transfer printer
- Also called a thermal transfer printer
- Generates rich, nonsmearing images by using heat to melt colored wax onto heat-sensitive paper
Step 1: Insert media card into digital camera. Take the photograph with your digital camera.

Step 2: Remove the media card from the digital camera and insert it into the card slot on the photo printer.

Step 3: Select desired image to print, number of copies, and size of print by pushing buttons on the photo printer.

Step 4: Remove the photo from the photo printer.

What is a photo printer?
- A color printer that can produce photo lab quality pictures as well as printing everyday documents.
- Many photo printers can read media directly from a digital camera.

What is a label printer?
- A small printer that prints on an adhesive type material that can be placed on a variety of items.
- Most also print bar codes.
- Some have built-in digital scales and can print e-stamps.
- An e-stamp, also called Internet postage, is digital postage you buy and print right from your personal computer.

What is a portable printer?
- A small, lightweight printer that allows a mobile user to print from a notebook or handheld computer while traveling.
- Printing technology: Ink jet, Thermal transfer.
- Connecting ports to computer: Parallel, USB, Wireless infrared.

What is a plotter?
- A sophisticated printer used to produce high-quality drawings.
- Used in specialized fields such as engineering and drafting.
- Uses a row of charged wires (called styli) to draw an electrostatic pattern on specially coated paper and then fuses toner to the pattern.

What is a large-format printer?
- Operates like an ink-jet printer, but on a much larger scale.
- Creates photo-realistic quality color prints.
- Used by graphic artists.
**What is an audio output device?**
- A component of a computer that produces music, speech, or other sounds, such as beeps
- Two commonly used audio output devices are speakers and headsets

**What types of speakers are available?**
- Most personal computers have a small internal speaker that usually outputs only low-quality sound
- Many users add sophisticated stereo speakers to generate a higher-quality sound
- Some users add a woofer to boost the low bass sounds

**When might you use a headset?**
- Useful when you are in a computer laboratory or some other crowded environment
- With a headset, only you can hear the sound from the computer

**What is voice output?**
- Occurs when you hear a person’s voice or when the computer talks to you through the speakers on the computer

**What is Internet telephony?**
- Voice output works with voice input
- Allows you to have a conversation over the Web, just as if you were on the telephone

**What is a data projector?**
- A device that takes the image from a computer screen and projects it onto a larger screen so an audience of people can see the image clearly
**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.

**Liquid crystal display (LCD) projector**
- Uses liquid crystal display technology.
- Attaches directly to a computer.
- Uses its own light source to display the information shown on the computer screen.

**What are two types of smaller data projectors?**
- LCD projector
- Digital light processing (DLP) projector

**What is a facsimile (fax) machine?**
- A device that transmits and receives documents over telephone lines.
- Documents can contain text, drawings, or photographs, or can be handwritten.
- A stand-alone fax machine scans an original document, converts the image into digitized data, and transmits the digitized image.

**What is a multifunction device (MFD)?**
- A single piece of equipment that looks like a copy machine, but provides the functionality of a printer, scanner, copy machine, and perhaps a fax machine.
- Sometimes called multifunction peripherals (MFPs), or all-in-one devices.

**What is a fax modem?**
- A modem that allows you to send (and sometimes receive) electronic documents as faxes.
- Transmits computer–prepared documents, such as a word processing letter, or documents that have been digitized with a scanner, or digital camera.

**What is a terminal?**
- A device that performs both input and output because it consists of a monitor (output), a keyboard (input), and a video card.

**Three basic categories**
- **Dumb terminals**
- **Intelligent terminals**
- **Special-purpose terminals**

**Terminal modem**

**External fax modem**
- Internal fax modem card in system unit.

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**What is a dumb terminal?**
- Has no processing power so it cannot function as an independent device.
- Can enter and transmit data to, or receive and display information from, a computer to which it is connected.
- Connect to a host computer that performs the processing and then sends the output back to the dumb terminal.
**Terminals**

**What is an intelligent terminal?**
- Has memory and a processor that has the capability of performing some functions independent of the host computer.
- Sometimes called programmable terminals because they can be programmed by the software developer to perform basic tasks.

**What is a point-of-sale (POS) terminal?**
- Records purchases at the point where the consumer purchases a product or a service.
- Output from POS terminals serve as input to other computers to maintain sales records, update inventory, verify credit, and perform other activities associated with the sales transactions that are critical to running the business.

**What is an automated teller machine (ATM)?**
- A self-service banking machine that connects to a host computer through a telephone network.
- Insert a plastic bankcard with a magnetic strip into the ATM.
- Enter your password, called a personal identification number (PIN), to access your bank account.

**Output Devices for Physically Challenged Users**

**What other output options are available for visually impaired users?**
- Change Window’s settings such as increasing the size or changing the color of the text to make the words easier to read.
- Blind users can work with voice output where the computer reads the information that displays on the screen.
- A Braille printer outputs information in Braille onto paper.

**Technology Trailblazer**

**Heidi Van Arnem**
- Chairman and CEO of iCan.com
- Helps to bring together businesses, the medical industry, government-led efforts, and nonprofit organizations to help enhance the lives of people with disabilities.
- A successful businesswoman, entrepreneur and inventor.
- A quadriplegic since 16, she established the Heidi Van Arnem foundation in 1992 to help find a cure for paralysis.
What are suggested output devices by user?

Small Office/Home Office
- 17- or 19-inch color CRT monitor
- High-definition television
- Ink-jet color printer; or Photo printer
- Label printer
- Speakers
- Headset

Mobile
- 15.4-inch color LCD display with a notebook computer
- 19-inch color CRT monitor for a notebook computer
- Docking station
- Color LCD display for handheld computer
- Portable printer
- Ink-jet color printer; or Laser printer, black and white, for in-office use; or Photo printer
- Fax modem
- Headset
- DLP data projector

Large Business
- 19- or 21-inch color CRT or LCD monitor
- 15.4-inch color LCD display for a notebook computer
- Color LCD display for handheld computer
- Laser printer, black and white
- Line printer (for large reports from a mainframe)
- Label printer
- Fax machine or fax modem
- Speakers
- Headset

Home
- 19-inch color CRT monitor

Summary
- What are output devices by user?