Module 6 - Input and Output

General Notes

What Is Input

Input is any data or instructions entered into a computer.

- It can come directly from you or from other sources.
- You provide input whenever you use system or application programs.
  - Sending a text message from a cell phone: You enter data in the form of numbers and letters and issue commands such as *send message* or *attach photo*.
  - You can also enter data and issue commands by pointing to items or using your voice.
  - Other sources of input:
    - Scanned or photographed images

Input Devices are hardware used to translate words, numbers, sounds, images, and gestures that people understand into a form that the system unit can process.

- Keyboards & Mice
- Pointing devices
- Scanning devices
- Image capturing devices
- Audio-input devices

Keyboard Entry

Keyboards convert numbers, letters, and special characters that people understand into electrical signals that are sent to, and processed by, the system unit.

- Most keyboards use an arrangement of keys called QWERTY.

Keyboards

There are three basic categories of keyboards:

- **Virtual**
  - Primarily used with cell phones and tablets.
- **Laptop**
- **Traditional**
  - The standard U.S. traditional keyboard has 101 keys.
    - Including function keys, navigation keys, and a numeric keypad.
    - Some keyboards include additional special keys *(such as the Windows key)*.
    - **Toggle keys** like Caps Lock turn a feature on or off.
    - **Combination Keys** like Ctrl perform an action when held down in combination with another key.

Pointing Devices

Pointing devices provide an intuitive interface with the system unit by accepting physical movements or gestures, such as a finger pointing or moving across a screen, and converting these movements into machine-readable input.

There's a wide variety of pointing devices, such as:

- Touch screen
- Mouse
- Game controller

Touch Screens

Touch screens allow users to select actions or commands by touching a screen with a finger or stylus.

- **Stylus:** A pen-like device typically used with tablets and mobile devices.
  - A stylus often interacts with the computer through handwriting recognition software.
- **Multi-touch screens** can be touched with more than one finger.

Mice

- A **mouse** controls a pointer that is displayed on the monitor.
- The **mouse pointer** usually appears in the shape of an arrow but frequently changes shape, depending on the application.
- Mice communicated detected movement through a cord or wirelessly through either radio waves or infrared light waves to communicate with the system unit.

Game Controllers

- **Game controllers** are devices that provide input to computer games.

Keyboards and traditional mice can be used as game controllers, but the four most popular and specialized game controllers are:

- **Joysticks**
  - Control game actions by users varying the pressure, speed, and direction of
    a control stick.
- **Gaming mice**
  - Similar to traditional mice with higher precision, faster responsiveness, and programmable buttons.
- Gamepads (like remote controllers for game consoles)
  - Designed to be held by two hands and provide a wide array of inputs, including motion, turning, stopping, and firing.
  - I.e. Console remote controllers
- Motion-sensing devices
  - Control games by user movement.

- I.e. Nintendo's Joy-Con controllers

Privacy

- Smart thermostats and smart refrigerators include microphones.
- Smart devices constantly listen to and record our conversations, sending them to researchers and scientists for analysis and study.

Scanning Devices

Scanning devices convert scanned text and images into a form that the system unit can process.

There are five types of scanning devices:

- Optical scanners
- Card readers
- Bar code readers
- RFID readers
- Character and mark recognition devices

Optical Scanners

- Also known as just a **scanner**.
- Scanners accept documents consisting of text and/or images and converts them to machine-readable form.
  - They do not recognize individual letters or images.
  - They recognize light, dark, and colored areas that make up individual letters or images.
  - Scanned documents are saved in files that can be further processed, displayed, printed, or stored for later use.

There are four basic types of optical scanners:

- **Flatbed Scanner**
  - Like a copy machine.
  - Image to be scanned is placed on a glass surface, adn the scanner records the image.
- **Document Scanner**

- - Similar to flatbed scanner except that it can quickly scan multi-page documents.
  - Automatically feeds one page of a document at a time through a scanning surface.
- **Portable Scanner**
  - Handheld device that slides across the image, making direct contact.
- **3D Scanner**
  - Uses lasers, cameras, or robotic arms to record the shape of an object.
  - Unlike 2D scanners, most 3D scanners cannot recognize light, dark, and colored areas.
  - 3D scanners recognize the shape of the object they are scanning.

Card Readers

- **Card readers** interpret encoded information that is stored on cards.
- The most common type of card reader is the **magnetic card reader**.
  - The encoded information is stored on a thin magnetic strip located on the back of the card.
  - The information is read when the card is swiped through the magnetic card reader.
- Many credit cards, known as **chip cards**, include additional security in the form of a microchip embedded in the credit card.
  - This chip contains encrypted data that makes it nearly impossible for criminals to forge a duplicate card.

Bar Code Readers

- **Bar code readers** or **scanners** are often either handheld **wand readers** or **platform scanners**.
- Bar code readers contain photoelectric cells that scan or read **bar codes**, or the vertical zebra-striped marks printed on product containers.

There are a variety of codes, including:

- **UPCs (Universal Product Codes)**
  - Widely used by retail stores to automate the processes to check out customers, to change product prices, and to maintain inventory records.
- **MaxiCode**

- Widely used by the United Parcel Service (UPS) and others to automate the process of routing packages, tracking in-transit packages, and locating lost packages.

RFID Readers

RFID (radio-frequency identification) tags are tiny chips that can be embedded in almost everything.

- These chips contain electronically stored information that can be read using an **RFID reader** located several yards away.
- Widely used to monitor and locate lost pets, track food from farm to table, and to record prices, product descriptions, and locations of retail items.

Character and Mark Recognition Devices

Character and mark recognition devices are scanners that are able to recognize special characters and marks.

- Specialty devices that are essential tools for certain applications.

The three types are:

- **Magnetic-ink Character Recognition (MICR)**
  - A special-purpose machine known as a reader/sorter reads these numbers and provides input that allows banks to efficiently maintain customer account balances.
  - Used by banks to automatically read those unusual numbers on the bottom of checks and deposit slips.
- **Optical-character Recognition (OCR)**
  - Uses special preprinted characters that can be read by a light source and changed into machine-readable code.
  - A common OCR device is the handheld wand reader, used in department stores to read retail price tags by reflecting light on the printed characters.
- **Optical-mark Recognition (OMR)**
  - Senses the presence or absence of a mark, such as a pencil mark.
  - OMR is often used to score standardized multiple-choice tests.

Image-Capturing Devices

Optical scanners can make or copy from an original. Imager-capturing devices create or capture original images.

These include:

- **Digital Cameras**
  - Capture images digitally and store the images on a memory card or in the camera's memory.
  - Provide a fast and easy way to create photos to share over social media and
    e-mail.
- **Webcams**
  - Specialized digital video cameras that capture images and send them to a computer for broadcast over the internet.
  - Popular videoconferencing apps, such as Zoom, Microsoft Teams, and Apple's FaceTime, use webcams to allow you to communicate in real time with friends
    and family using live video.

Audio-Input Devices

Audio-input devices convert sounds into a form that can be processed by the system unit.

- By far the most widely used audio-input device is the microphone.
- Audio input can take many forms, including the human voice and music

Voice Recognition Systems

Voice recognition systems use a microphone, a sound card, and special software.

- Allow users to operate computers and other devices, as well as to create documents, using voice commands.
- Specialized portable voice recorders are widely used by doctors, lawyers, and others to record dictation.

What Is Output

Output is processed data or information.

- Output typically takes the form of:
  - Text
  - Graphics
  - Photos
  - Audio
  - Video
- When you create a presentation using a presentation graphics program, you typically input text and graphics. You also could include photographs, voice narration, and even video. The output would be the completed presentation,

Output devices are any hardware used to provide or to create output.

- They translate information that has been processed by the system unit into a form that humans can understand.
- There are a wide range of output devices. The most widely used are:
  - **Monitors**
  - **Printers**
  - **Audio-output Devices**

Monitors

- Monitors are the most frequently used output devices.
- Also known as **display screens**.
- Monitors present visual images of text and graphics.
- Monitors vary in size, shape, and cost.
- Almost all monitors have basic distinguishing features.

Features

The most important characteristic of a monitor is its **clarity**.

- **Clarity:** Refers to the quality and sharpness of the displayed images. It is a function of several monitor features, including:
  - **Resolution**
  - **Dot pitch**

- - Contrast ratio
  - Active display area
  - Aspect ratio
- Another important feature is the ability to accept touch or gesture input.
  - Not present in older monitors, although it is becoming standard in newer monitors.

Resolution

- One of the most important features.
- Resolution is expressed as a grid of the series of dots or pixels that form images on a monitor.

Standard	Pixels
HD 720	1280 x 720
HD 1080	1,920 x 1,080
WQXGA	2,560 x 1,600
UHD 4K	3,840 x 2,160
UHD 8K	8,192 x 4,608

Dot (Pixel) Pitch

- The distance between each pixel.
- The lower the dot pitch, the clearer the images.
- Most newer desktop monitors have a dot pitch below 0.30mm.
- Cell phones have dot pitches below 0.05mm since they are designed to be viewed more closely.

Contrast Ratios

- Indicate a monitor's ability to display images.
- It compares the light intensity of the brightest white to the darkest black.
- The higher the ratio, the better the monitor.
- Good monitors have a contrast ratio above 1,000:1

Active Display Area

- Size
- Measured by the diagonal length of a monitor's viewing area.
- Common sizes are:
    - 15 inches
    - 17 inches
    - 19 inches
    - 21 inches
    - 24 inches

Aspect Ratio

- Indicates the proportional relationship between a display's width and height.
- Older, square-shaped monitors have a 4:3 aspect ratio.
- Newer monitors have a 16:9 aspect ratio, designed to display widescreen content.

Calibrating a Monitor

1. Warm up the TV or monitor for half an hour before calibration
2. Set the display resolution to its default (or native) resolution
3. Calibrate in a room with ambient light.
    - Direct light on the screen can make it difficult to accurately asses your display's picture quality.
4. Select your picture mode
    - For true color representation, look for **THX** or **ISF** modes. If those are not present, use **cinema** or **theater** mode.
5. Use software tools
    - Windows and macOS come with free monitor calibration tools.
    - THX Tune-up app is a premium tool you can use.

Flat-Panel Monitors

- Most widely used monitor today.
- Compared to other types, they are thinner, more portable, and require less power to operate.

- Almost all are backlit, meaning that a common source of light is dispersed over all the pixels on the screen.

There are three types of flat-panel monitors:

- **LCD (Liquid Crystal Display)**
    - Widely used for older monitors.
    - Less expensive
- **LED (Light-Emitting Diode)**
    - Use similar technology with a more advanced backlighting technology.
    - Produce better-quality images, are slimmer, and more environmentally friendly as they require less power and use fewer toxic chemicals to manufacture.
    - Most new monitors are LED.
- **OLED (Organic Light-Emitting Diode)**
    - Replace the LED monitor's backlighting technology with a thin layer of organic compound that produces light.
    - OLED monitors are even thinner, with better power efficiency and contrast ratios, because they eliminate the backlight.

E-book Readers

E-book readers (e-readers) are dedicated mobile devices for storing and displaying e-books and other electronic media, including electronic newspapers and magazines.

- Typically use **e-ink**, a technology that produces images that reflect light like ordinary paper, making the display easy to read.
- Two well-known e-readers:
    - Amazon's Kindle
    - Walmart's Kobo eReaders

Other Monitors

- Some other types of monitors are used for more specialized applications, such as making presentations or watching television.

Some other types of monitors:

- **Digital** or **Interactive Whiteboards**

- Specialized devices with a large display connected to a computer or projector.
- Computer's desktop is displayed on the digital whiteboard and controlled using a special pen, a finger, or some other device.
- Widely used in classrooms and corporate boardrooms.
- **Flexible Screens**
  - Allow digital devices to display images on nonflat services.
  - I.e. Cell phones with screens that wrap around the edges of the phone and curved monitors whose edges wrap toward the viewer.
    - Samsung Galaxy Fold
- **Digital Projectors**
  - Project images from a traditional monitor onto a screen or wall.

Printers

- Printers are one of the most used output devices.
- Printers translate information that has been processed by the system unit and present the information on paper.

Features

Almost all printers have the following basic distinguishing features:

- **Resolution**
  - Similar to monitor resolution, it is a measure of the clarity of images produced.
  - Measured in **dpi (dots per inch)**.
  - Personal printers average 1,200 by 4,800 dpi.
- **Color Capability**
  - The most common black ink selection is **grayscale**, in which images are displayed using many shades of gray.
- **Speed**
  - Measured in the number of pages printed per minute.
  - Personal printers average 15 to 19 pages per minute for single color (black) output, and 5 to 12 pages per minute for color output.
- **Memory**
  - Used to store printing instructions and documents waiting to be printed.
  - The more memory, the faster it will be able to print large documents.

- **Duplex Printing**
  - Allows automatic printing on both sides of a sheet of paper.
  - Not currently a standard feature for all printers, but will likely become one in the future to reduce paper waste.
- **Connectivity**
  - The ability to connect to a network, eliminating the need for a computer to be attached by a cable to the printer and making it easier for multiple computers to share one printer.

Inkjet Printers

- Spray ink at a high speed onto the surface of paper.
- Produces high-quality images in a variety of colors, making it ideal for printing photos.
- Most widely used printers.

Laser Printers

- Use technology similar to photocopying machines.
- Use a laser light beam to produce images with excellent letter and graphics quality.
- More expensive than Inkjet printers.
- Used in applications requiring high-quality output.

There are two categories of laser printers:

- **Personal Laser Printers**
  - Less Expensive
  - Used by a single user
  - Can print 15 to 17 pages a minute
- **Shared Laser Printers**
  - More expensive
  - Shared by a group of users
  - Can print over 50 pages a minute
  - Support color

3D Printers

- Create three-dimensional shapes by adding very thin layer after layer of material until the final hsape is fully formed.
  - Known as **additive manufacturing**
- Variety of different processes and materials can be used to create each layer.
  - One of the most common extrudes a liquid plastic or other substance through a nozzle similar to an inject printer.
- Controlled by data describing the shape of the object to be created.
  - Typically a file created by a 3D modeling program or from scanning a physical model using a 3D scanner.
- Volkswagen uses 3D printers in its production lines to produce gear knobs and custom tailgate lettering.

Other Printers

- **Cloud Printers**
  - Connected to the Internet and provide printing services to others on the internet.
  - **Google Cloud Print** is an example that allows a user to print from anywhere on any device to a printer that is activated using the Google Chrome OS.
- **Thermal Printers**
  - Use heat elements to produce images on heat-sensitive paper.
  - Widely used with ATMs and gasoline pumps to print receipts.
- **Plotters**
  - Special-purpose printers for producing a wide range of specialized output.
  - Using output from graphics tablets and other graphical devices, plotters create maps, images, and architectural and engineering drawings.
  - Typically used by graphic artists, engineers, and architects to print out designs, sketches, and drawings.

Audio-Output Devices

- Audio-output devices translate audio information from the computer into sounds that people can understand.
- The most widely used audio-output devices are **speakers** and **headphones**.

- They connect to a sound card within the system unit by either cable or wirelessly using **bluetooth**.
- It is much easier to create voice output than to recognize and interpret voice input.

# Combination Input and Output Devices

Common combination devices:

- **Headsets**
  - Combine the functionality of microphones and headphones.
  - The microphone accepts audible input and the headphones provide audio output.
- **Multifunctional Devices (MFD)**
  - Combine the capabilities of a scanner, printer, fax, and copy machine.
  - Less expensive than purchasing the individual components, but more likely to break down.
  - A device with a single purpose in mind (such as a scanner) is more likely to have professional-level features and perform faster than a MFD.
  - Not as reliable, because problems with one of the functional parts can make the entire device inoperable.
- **Virtual Reality (VR) Head-mounted Displays and Controllers**
  - Artificial, or simulated, reality created in 3D by computers.
  - **VR head-mounted displays**
    - Use earphones, stereoscopic screens to present 3D images, and gyroscopic sensors to interpret head orientation.
  - **VR controllers**
    - Use sensors that collect data about your hand movements coupled with software.
- **Drones** or **Unmanned Aerial Vehicles (UAVs)**
  - Take input from a radio joystick or Wii-Fi-connected tablet or laptop.
  - The drones act as an output device, sending back video and sound to the user.
  - Used in civil engineering, amateur cinematography, agriculture to apply pesticides and monitor livestock, disaster relief to look for people in distress, and by the post office to deliver mail.
- **Robots**

- Use cameras, microphones, and other sensors as inputs.
  - Found everywhere, including vacuuming floors in homes, assembling cars in factories, and aiding surgeons in hospitals.

Ergonomics

- **Ergonomics *(er-guh-nom-ix)*:** The study of human factors related to things people use.
  - Concerned with fitting the task to the user rather than forcing the user to contort to do the task.
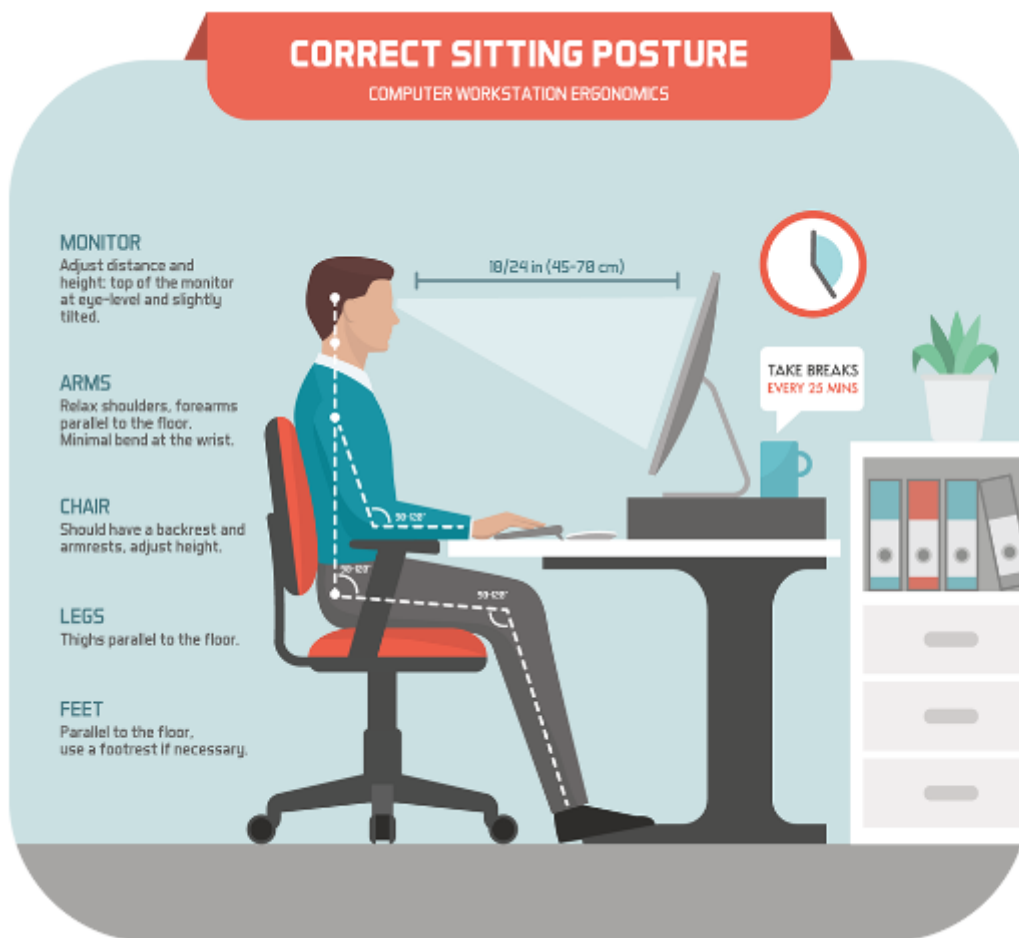
Other recommendations to avoid physical discomfort:

- **Eyestrain and Headache**
  - Take a 15-minute break every hour or two
  - Keep everything you're focusing on at about the same distance
  - Clean the screen of dust from time to time
- **Back and Neck Pain**
  - Make sure equipment is adjustable
  - The monitor should be at eye level or slightly below eye level

- - Use a footrest to reduce leg fatigue
  - **Repetitive Strain Injury (RSI)**
    - RSI is any injury caused by fast, repetitive work that can generate neck, wrist, hand, and arm pain.
    - **Carpal tunnel syndrome** is an example and can be avoided by getting an ergonomically correct keyboard.
      - Also take frequent short rest breaks and gently massage your hands

Portable Computers

Recommendations for ergonomics with the following portable computers:

- **Cell Phones**
  - Pain occurs at the base or in the muscles of the thumb or wrist. Minimize this by:
    - Keeping wrists straight (not bent)
    - Head up
    - Shoulders straight
    - Frequently resting thumbs by using other fingers
- **Tablets**
  - Pain occurs in the neck and back due to *tablet hunch*, where the user improperly aligns his or her head to the viewing surface. Minimize this by:
    - Taking frequent breaks
    - Moving around while working
    - Using a tablet cover or stand that allows the screen to be tipped at various angles
    - Using an external keyboard
- **Laptops**
  - It's impossible to position the keyboard or screen for safe ergonomic use.
  - To minimize the negative impact:
    - Raise the level of the screen by using books or reams of paper under the laptop and attach an external keyboard to be used at waist level.

Careers In IT

Technical writers prepare instruction manuals, technical reports, and other scientific or technical documents.

- Most technical writers work for computer software firms, government agencies, or research institutions.
- They translate technical information into easily understandable instructions or summaries.
- As new technology continues to develop and expand, the need for technical writers who can communicate technical expertise to others is expected to increase.
- Typically require an Associates or Bachelor's degree in communications, journalism, or English and a specialization in, or familiarity with, a technical field.