

Chapter 4:

Input and Output Devices

Learning Objectives

1. Explain the purpose of a computer keyboard and the types of keyboards widely used today.
2. List several different pointing devices and describe their functions.
3. Describe the purposes of scanners and readers and list some types of scanners and readers in use today.
4. Explain what digital cameras are and how they are used today.
5. Understand the devices that can be used for audio input.
6. Describe the characteristics of a display device and explain some of the technologies used to display images.
7. List several types of printers and explain their function.
8. Identify the hardware devices typically used for audio output.

Overview

- This chapter covers:
 - Different types of keyboards and pointing devices
 - Types of scanners, readers, and digital cameras
 - Audio input devices
 - Types of display devices and how they work
 - Types of printers and how they work
 - Audio output

Keyboards

- Keyboard
 - An input device used to enter characters at the location marked by the insertion point or cursor
 - Can be wired or wireless
 - Most computers today are designed to be used with a keyboard
 - Typically contains:
 - Standard alphanumeric keys
 - Numeric keypad
 - Function keys
 - Delete and Backspace keys
 - Control and Alternate keys
 - Arrow directional keys and special keys

Keyboards

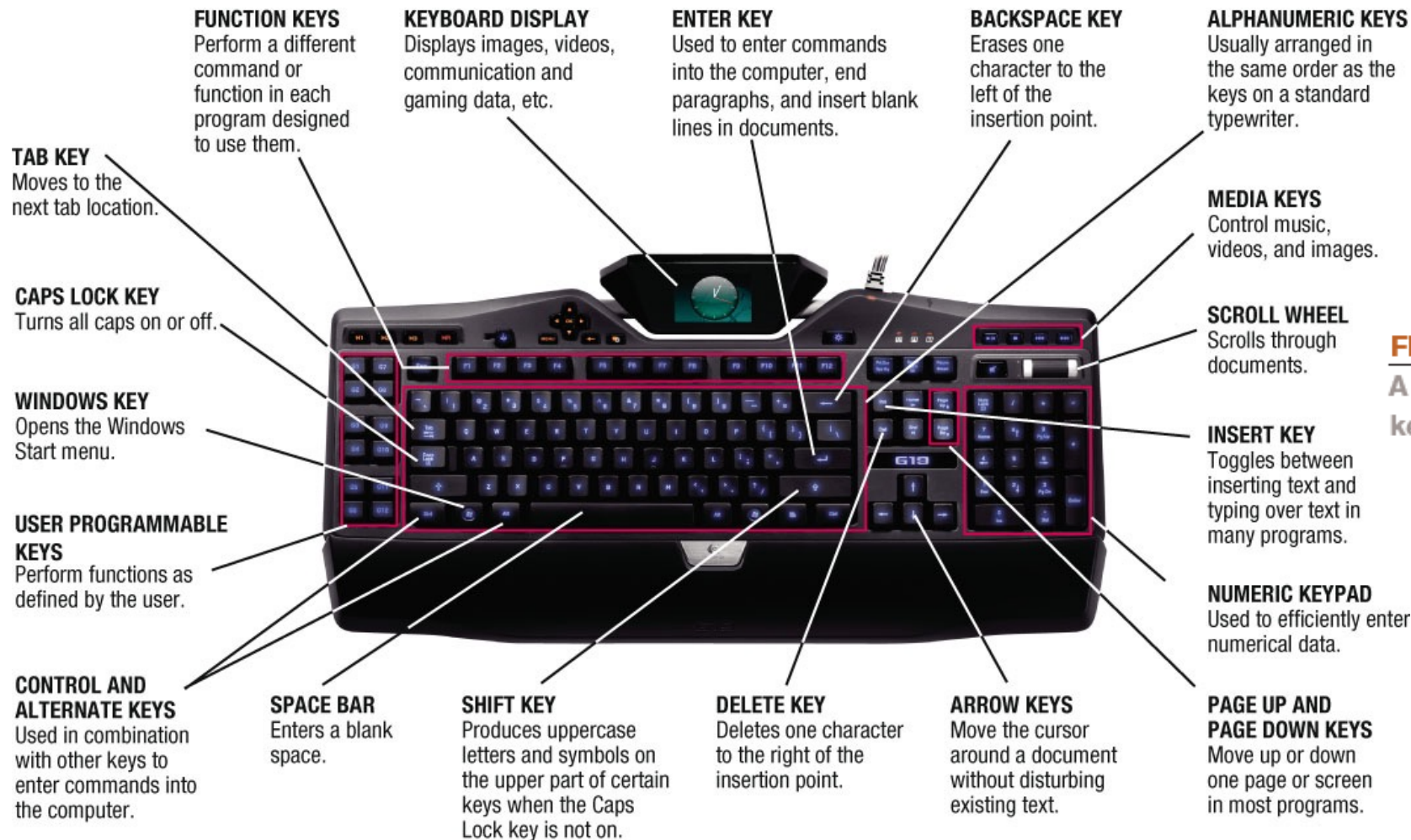


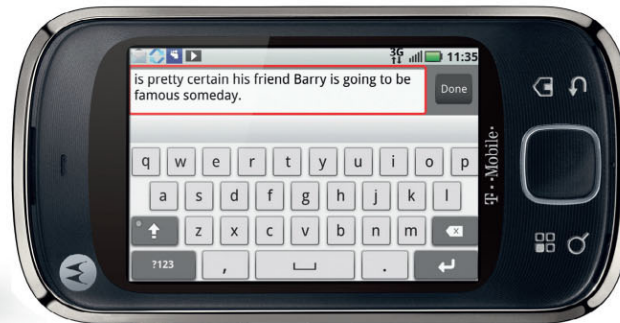
FIGURE 4-1
A typical desktop keyboard.

Keyboards

- Portable computers and mobile devices often use:
 - Built in or slide-out keyboard
 - Pen or touch input (on-screen keyboard)
 - Keyboard dock



Photo courtesy of Nokia.



Courtesy of T-Mobile USA



This keyboard dock is built into a portable case.

Courtesy Kensington

FIGURE 4-2
Keyboards for mobile devices.

Pointing and Touch Devices

- Pointing Devices are used to:
 - Select and manipulate objects
 - Input data
 - Issue commands to the computer
- Common Types of Pointing Devices:
 - Mouse
 - Pen/stylus
 - Touch screen

Pointing and Touch Devices

- Mice
 - Mouse
 - Common pointing device that the user slides along a flat surface to move a pointer around the screen and clicks its buttons to make selections
 - Older mechanical mice use a ball
 - Optical or laser mice track with light
 - 3D mice
 - Can be wireless

Pointing and Touch Devices

FIGURE 4-3

Examples of mice.



Courtesy of Logitech

LASER MICE

FIGURE 4-4

Common mouse operations.



Courtesy 3Dconnexion

3D MICE

POINT

Move the mouse until the mouse pointer is at the desired location on the screen.



CLICK

Press and release the left mouse button.



RIGHT-CLICK

Press and release the right mouse button.



DOUBLE-CLICK

Press and release the left mouse button twice, in rapid succession.



DRAG-AND-DROP

When the mouse pointer is over the appropriate object, press and hold down the left mouse button, drag the object to the proper location on the screen by moving the mouse, and then drop the object by releasing the mouse button.



SCROLL WHEEL/BUTTON

If your mouse has a wheel or button on top, use it to scroll through the displayed document.



steamroller_blues/Shutterstock.com

Pointing and Touch Devices

- Pens/Styluses
 - Stylus
 - Pen-like device used to draw or write electronically on the screen
 - Also called digital pen, electronic pen, tablet pen
 - Pen input is being used for
 - Photography, graphic design, animation
 - Industrial design, document processing, and healthcare applications
 - Issuing commands and inputting data

Pointing and Touch Devices

- Pen-Based Computers
 - Pen input used with mobile devices and tablet computers
 - Used to input handwritten text and sketches and to manipulate text
 - If handwriting recognition is used, written text can be converted to editable typed text



Courtesy Intermec Technologies

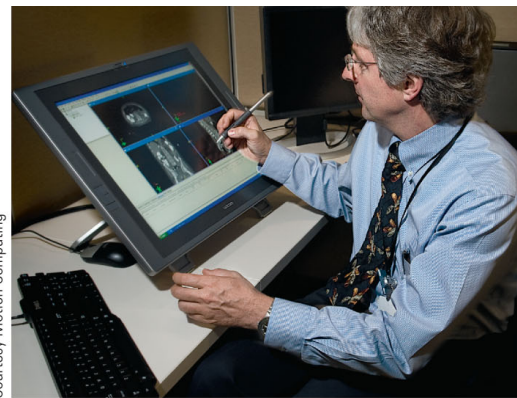
Stylus

MOBILE DEVICES



Courtesy Motion Computing

TABLET COMPUTERS



Courtesy Wacom Technology Corp.

DESKTOP COMPUTERS

FIGURE 4-5
Pen-based computers.

Pointing and Touch Devices

The image displays two overlapping screenshots of the Mi-Forms software interface, which is used for creating digital forms for skilled nursing visits. The forms are titled "SKILLED NURSING VISIT NOTE" and include fields for patient information, date, time, and medical record number. The left screenshot shows the "CARDIOVASCULAR" section with a red arrow pointing to the "Edema (specify)" field. The right screenshot shows the "DIGESTIVE" section. Both forms include fields for patient name, date, time, and medical record number. The left screenshot also shows the "RESPIRATORY" section with a "CHECK COUGH" button. The right screenshot shows the "GENITOURINARY" section with a "CHECK COUGH" button. The Mi-Forms logo is visible in the bottom left corner of both screenshots.

FIGURE 4-6

Digital forms. If the software supports it, the text handwritten on a digital form can be converted by the computer to typed text.

Pointing and Touch Devices

- Digital Writing Systems
 - Pen-based systems that capture handwritten input as it is being written
 - Requires special paper with a grid of dots
 - Handwritten input can be transferred to computer
- Graphics Tablets
 - Pen tablets or digitizing devices
 - Flat, touch sensitive tablet typically connected to computer using a USB port

Pointing and Touch Devices

- Signature Capture Devices
 - Found at check out counters to record customer signatures



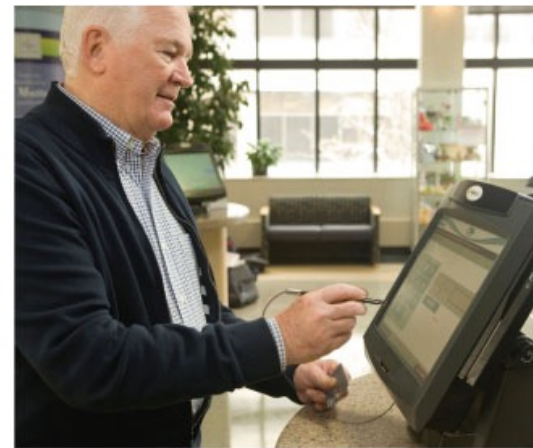
DIGITAL WRITING SYSTEMS

Record all input written on the paper and transfer it to a computer upon demand.



GRAPHICS/PEN TABLETS

Transfer all input written or drawn on the tablet to the computer in real time and allow the use of flicks and other pen navigation tools.



SIGNATURE CAPTURE DEVICES

Record signatures for purchases, deliveries, and other applications that require recorded authorization.

FIGURE 4-7
Other uses for
digital pens.

Pointing and Touch Devices

- Touch Screens
 - Display devices that are touched with the finger to select commands or otherwise provide input to the computer
 - Used with:
 - Desktop and portable computers
 - Mobile phones and other mobile devices
 - Surface computing
 - Multi-touch input from multiple users and object recognition
 - Consumer kiosks and Point-of-Sale systems

Pointing and Touch Devices



DESKTOP COMPUTERS



PORTABLE COMPUTERS

FIGURE 4-8
Touch screens.



MOBILE DEVICES



SURFACE COMPUTING DEVICES

Pointing and Touch Devices

- Other Pointing Devices
 - Joysticks, gamepads, and other gaming devices
 - Trackballs
 - Buttons and wheels
 - Touch pads



GAMING DEVICES
Most often used for gaming applications.



CONTROL BUTTONS
Commonly found on portable digital media players and other consumer devices.



TOUCH PADS
Commonly found on notebook and netbook computers.

FIGURE 4-9
Other common pointing devices.

Quick Quiz

1. An optical mouse is _____.
 - a. the same as a wireless mouse
 - b. a mouse that tracks movements with light instead of a ball
 - c. a mouse that contains a scroll wheel on the top
2. True or False: With handwriting recognition, text is input as a graphical image so the text cannot later be edited as text.
3. An input device that looks like an upside-down mouse with the ball on top is a(n) _____.

Answers:

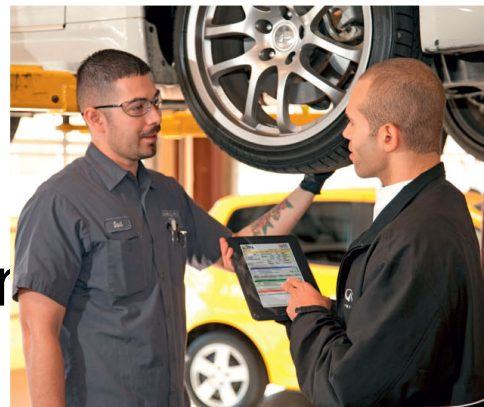
1) b; 2) False; 3) trackball

Scanners, Readers, and Digital Cameras

- Source Documents
 - Containing data that already exists in physical form (order form, photograph, invoice, check, or price label)
- Source Data Automation
 - Captures data directly from a source document
 - Saves time
 - Increases accuracy
 - Utilizes scanning or reading devices

FIGURE 4-10

Source data automation.



Courtesy Motion Computing

**RECORDING DATA DIRECTLY INTO
A COMPUTER**



Courtesy Intermed Technologies

**CAPTURING DATA FROM ITS SOURCE
DOCUMENT**

Scanners, Readers, and Digital Cameras

- Scanners (Optical Scanners)
 - Input devices that capture an image of an object and transfers it to a computer in digital form
 - Can scan photos, documents, drawings (flat objects)
 - Data is typically input as a single image
 - If optical character recognition (OCR) is used, text is input as individual text characters
 - Types of scanners
 - Flatbed
 - Portable
 - 3D
 - Integrated (ATMs, etc.)

Scanners, Readers, and Digital Cameras

FIGURE 4-11
Scanners.



Courtesy, Hewlett-Packard Company

FLATBED SCANNERS

Used to input photos, sketches, slides, book pages, and other relatively flat documents into the computer.



Courtesy WizCom Technologies

PORTABLE SCANNERS

Used to capture small amounts of text; the text is typically transferred to a computer at a later time.



Courtesy of NCR Corporation

INTEGRATED SCANNERS

Built into other devices, such as into the ATM machine shown here to capture images of deposited checks.

Scanners, Readers, and Digital Cameras

- Scanning Quality and Resolution
 - Quality of scanned images indicated by optical resolution
 - Measured in number of dots per inch (dpi)
 - Can often be specified when image is scanned
 - Can be changed when scanned image is edited
 - Varies with scanner used
 - Higher resolution means better quality but larger file size

FIGURE 4-12
Scanning resolution.



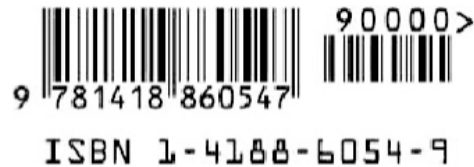
RESOLUTION

Most scanners let you specify the resolution (in dpi) to use for the scan. High-resolution images look sharper but result in larger file sizes.

Scanners, Readers, and Digital Cameras

- Readers
 - Barcode Readers
 - Input devices that read barcodes
 - Barcodes
 - Machine-readable codes that represent data as a set of bars
 - Common Types
 - Universal Product Code (UPC)
 - ISBN
 - Code 39 - nonfood use
 - Intelligent mail barcode - US Postal Service
 - Two Dimensional 2D (QR) - stores more data

Scanners, Readers, and Digital Cameras



ISBN CODES



**UPC (UNIVERSAL
PRODUCT CODE) CODES**



DATABAR CODES



INTELLIGENT MAIL CODES



CODE 39 CODES



QR CODES

FIGURE 4-13

Common types of
barcodes.

Courtesy of Motorola

Scanners, Readers, and Digital Cameras

FIGURE 4-14

Barcode readers.



Courtesy of NCR Corporation

FIXED BARCODE READERS

Used most often in retail point-of-sale applications.



Courtesy of Motorola Solutions

PORTABLE BARCODE READERS

Used when portability is needed.



Courtesy of SPARCCode

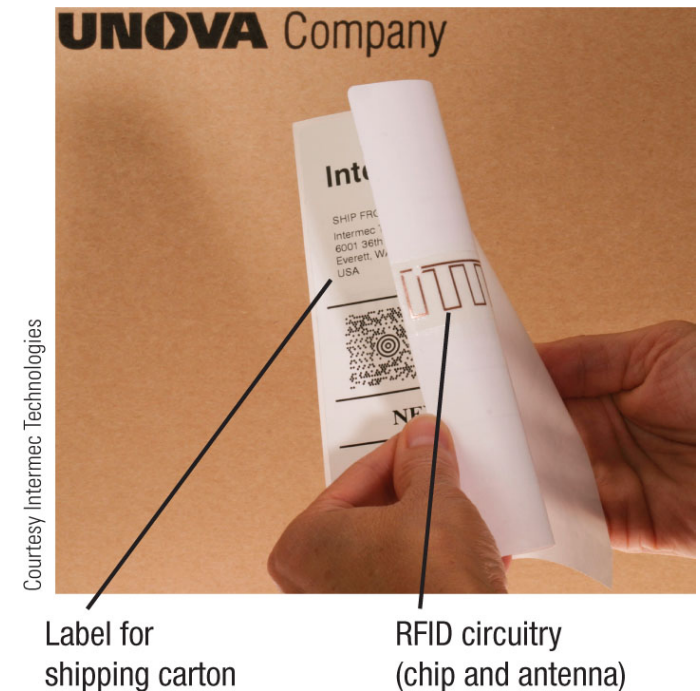
INTEGRATED BARCODE READERS

Used most often for consumer applications.

Scanners, Readers, and Digital Cameras

- Radio Frequency Identification (RFID) Readers
 - Technology used to store and transmit data located in RFID tags
 - RFID tags contain tiny chips and radio antennas
 - Attached to objects for identification purposes
 - Read by RFID readers
 - Tags only need to be within range of the reader, rather than in the line of sight

FIGURE 4-15
RFID tags.



Scanners, Readers, and Digital Cameras

- Applications
 - Tracking inventory and assets
 - Electronic tolls
 - Tracking patients in hospitals
 - Ticketing applications
 - Security: Speeding up ID process
- Types of RFID Readers
 - Handheld
 - Portal
 - Stationary
- Slow to catch on in retail industry due to privacy and security issues

Scanners, Readers, and Digital Cameras



Courtesy Intermed Technologies

INVENTORY TRACKING

This portal RFID reader reads all of the RFID tags attached to all of the items on the pallet at one time.



Courtesy of teamavex.com

TICKETING APPLICATIONS

This stationary RFID reader is used to automatically open ski lift entry gates for valid lift ticket holders at a ski resort in Utah.



Courtesy MasterCard Worldwide

MOBILE PAYMENTS

This stationary RFID reader is used at checkout locations to quickly process payments via RFID-enabled credit cards or mobile phones.



AP Images/Denis Poroy

BORDER SECURITY

This stationary RFID reader is used at the U.S.-Mexico border crossing located in San Diego to reduce wait time.

FIGURE 4-16
RFID applications.

Scanners, Readers, and Digital Cameras

- Optical Mark Readers (OMRs)
 - Input data from special forms to score or tally exams, questionnaires, ballots
- Optical Character Recognition (OCR) Devices
 - OCR is the ability of a computer to recognize scanned text characters and convert them to electronic form as text, not images
 - OCR readers can recognize many different types of printed characters
 - Used to process turnaround documents like monthly bills

Scanners, Readers, and Digital Cameras

FIGURE 4-17

Optical mark readers (OMRs).
OMRs are commonly used to score tests and tally questionnaires.



Courtesy Scantron Corporation®

PLEASE RETURN THIS PORTION WITH PAYMENT

NVEnergy™

Service Address: 123 MAPLE ST.
LAS VEGAS NV 89135

ACCOUNT NUMBER:
300011111311111139

MAKE CHECKS PAYABLE TO NV ENERGY

BALANCE FORWARD	.00
CURRENT CHARGES	135.86
TOTAL AMOUNT DUE	\$135.86

Current Charges due by Apr 5, 2013

Please enter amount paid below
\$ _____

9965.3.86.18458 1 AV 0.324 oz 0.733

JOHN SMITH
123 MAPLE ST.
LAS VEGAS NV 89135

89520-3086

300011111311111139 0000013586 0000013586 0 000

Courtesy of NV Energy

OPTICAL CHARACTERS

These OCR characters indicate the customer account number and amount due and can be read by both computers and humans.

FIGURE 4-18

Optical characters.

The most common use of optical characters is in turnaround documents, such as on the utility bill shown here.

Scanners, Readers, and Digital Cameras

– Magnetic Ink Character Recognition (MICR) Readers

- Also called check scanners
- Used primarily for banking
- Read the special magnetic characters printed at the bottom of checks
- High volume readers sort and process deposited checks
- Used to facilitate remote deposits and electronic check processing



Courtesy Epson America

FIGURE 4-19

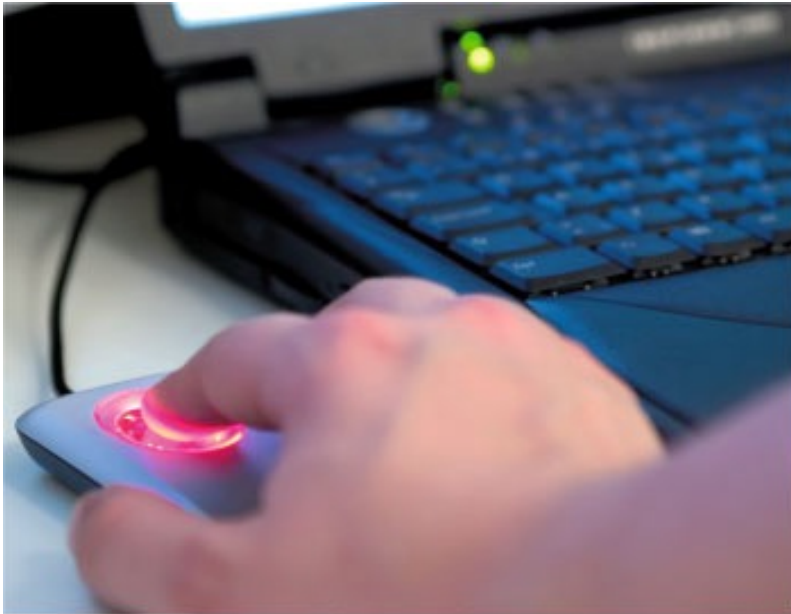
Magnetic ink character recognition (MICR) readers are used primarily to process checks.

Scanners, Readers, and Digital Cameras

– Biometric Readers

- Used to input biometric data--science of identifying individuals based on measurable biological characteristics
 - Fingerprint, hand or face geometry, voice or signature
- Can be stand-alone or built into another piece of hardware
- Used to allow access only by authorized individuals
- Most often used for access control, to verify transactions, and to authorize electronic payments

Scanners, Readers, and Digital Cameras



STAND-ALONE FINGERPRINT READERS

Often used to control access to facilities or computer systems, such as to the notebook computer shown here.



BUILT-IN FINGERPRINT READERS

Often used to control access to the device into which the reader is built or to verify an individual's identity using that device, such as for law enforcement purposes as shown here.

FIGURE 4-20
Biometric readers.

Scanners, Readers, and Digital Cameras

- Digital Cameras
 - Record images on digital storage medium rather than film
 - Can either be still cameras or video cameras
 - Integrated into many portable computers and mobile phones.
- Digital Still Cameras
 - Available in a wide variety of sizes and capabilities
 - Primary appeal is images are immediately available
 - Camera quality is measured in megapixels
 - Typically use flash memory for storage
 - Camera phones can be used to read barcodes, for mobile deposit, etc.

Scanners, Readers, and Digital Cameras



Scanners, Readers, and Digital Cameras

- Digital Video Cameras
 - Digital camcorders, PC video cameras (PC cams, Web cams)
 - Built-in or stand alone
 - Store images on digital media (flash memory, DVDs, hard drives, etc.)
- Applications
 - Surveillance video cameras
 - Video conferences and Webinars
 - Face recognition systems



Courtesy of Sony Electronics Inc.

DIGITAL CAMCORDERS

Typically store video on a built-in hard drive (as in this camera) or on DVD discs.



Stand-alone video camera

PC VIDEO CAMERAS

Commonly used to deliver video over the Internet, such as during a video phone call as shown here.

FIGURE 4-22

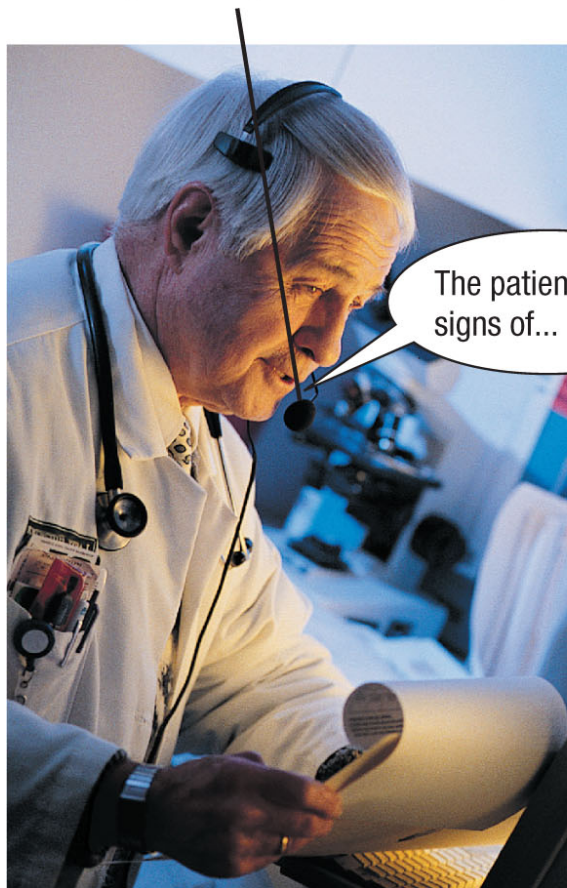
Digital video cameras.

Audio Input

- Voice Input and Speech Recognition Systems
 - Audio Input
 - The process of entering audio data into the computer
 - Voice Input
 - Inputting spoken words and converting them to digital form via microphone or headset
 - Recorded for narrations, podcasts, etc.
 - VoIP (Voice over IP systems) applications
 - Provides spoken instructions to computer when used with speech recognition systems

Audio Input

1. The user speaks into a microphone that cancels out background noise and inputs the speech into the computer.



Courtesy David Shopper and Nuance Communications, Inc.

2. An analog-to-digital converter on the sound card located inside the system unit converts the spoken words to phonemes, the fundamental sounds in the language being used, and digitizes them.



Dmitry Melnikov/Shutterstock.com

3. Voice recognition software determines the words that were spoken.
4. The spoken words appear on the screen in the application program (such as a word processor or an e-mail program) being used.

FIGURE 4-23
Speech recognition systems.

Audio Input

- Music Input Systems
 - Used to input music
 - Existing music can be input using CDs or a Web download
 - For original compositions, microphones and keyboard controllers (piano keyboards) can be connected to a computer



FIGURE 4-24
Music input systems. Musicians can input original compositions into a computer via microphones, MIDI keyboards, and other devices.

Quick Quiz

1. Which of the following is used in conjunction with Scantron test forms, voting ballots, and other documents in which the selection is bubbled in?
 - a. OCR
 - b. MICR
 - c. OMR
2. True or False: Flatbed scanners can be used to scan photos, as well as documents on conventional paper.
3. A voice input system requires software and a(n) _____ in order to input voice data or commands into a computer.

Answers:

1) c; 2) True; 3) microphone

Display Devices

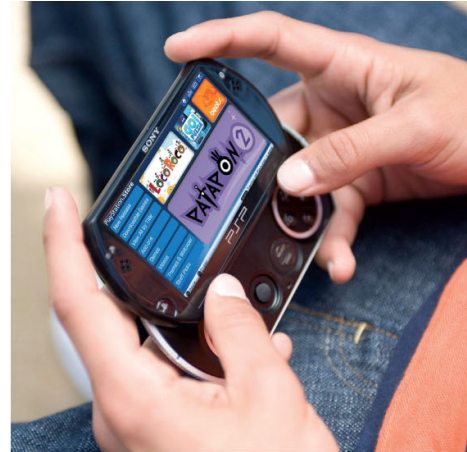
- Display Device
 - Presents output visually on some type of screen
 - Monitor
 - Display device for a desktop computer
 - Display Screen
 - Screen built into a variety of devices
 - Notebook and other portable computers
 - Mobile phones and mobile devices
 - Handheld gaming devices, home entertainment devices, kitchen appliances
 - Digital photo frames, e-book readers
 - Digital signage systems, digital billboards

Display Devices



Andrew Buckin/Shutterstock.com

PORTABLE COMPUTERS



Courtesy of Sony Electronics Inc.

HANDHELD GAMING DEVICES



Courtesy of Sony Electronics Inc.

DIGITAL PHOTO FRAMES



Courtesy of Samsung

MOBILE DEVICES

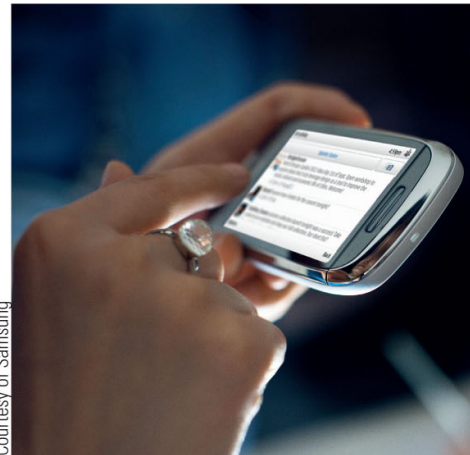
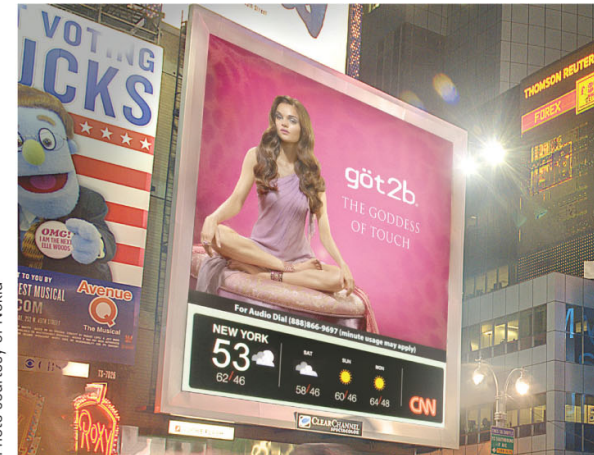


Photo courtesy of Nokia

DIGITAL SIGNAGE SYSTEMS



Courtesy of Clear Channel Spectacolor

FIGURE 4-25
Uses for display devices.

Display Devices

- Display Device Characteristics
 - Color vs. Monochrome Displays
 - Images are formed using pixels
 - Most displays today are color displays
 - CRT vs. Flat-Panel Displays
 - Cathode ray tube (CRT) displays are large, bulky, and heavy
 - Flat-panel displays take up less desk space and use less power than CRTs

FIGURE 4-26

Flat-panel displays. The smaller footprint of a flat-panel display makes it possible to use multiple monitors together with a single computer to increase productivity.

Four flat-panel monitors.



Courtesy CineMassive Displays

Display Devices

- Size and Aspect Ratio
 - Device size measured diagonally from corner to corner
- Screen Resolution
 - Number of pixels used on a display determines resolution



1,280 × 768



1,600 × 900

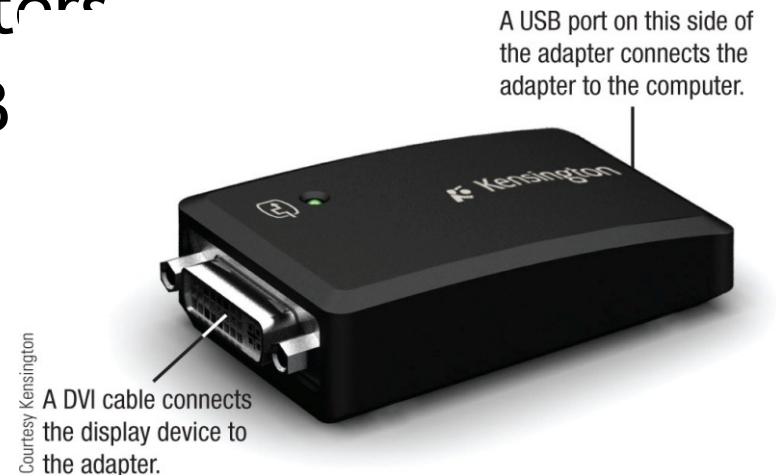
FIGURE 4-27
Screen resolution.

A higher screen resolution (measured in pixels) displays more content than a lower screen resolution, but everything is displayed smaller.

Display Devices

- Video adapters, Interfaces, and Ports
 - Video cards determine the graphic capabilities of a computer
 - VGA, DVI, and HDMI are the three most common interfaces to connect monitors to a computer
 - Ports exposed in the system unit cases are to connect monitors to computers
 - New option is to use USB ports

FIGURE 4-29
A USB display adapter.



Display Devices

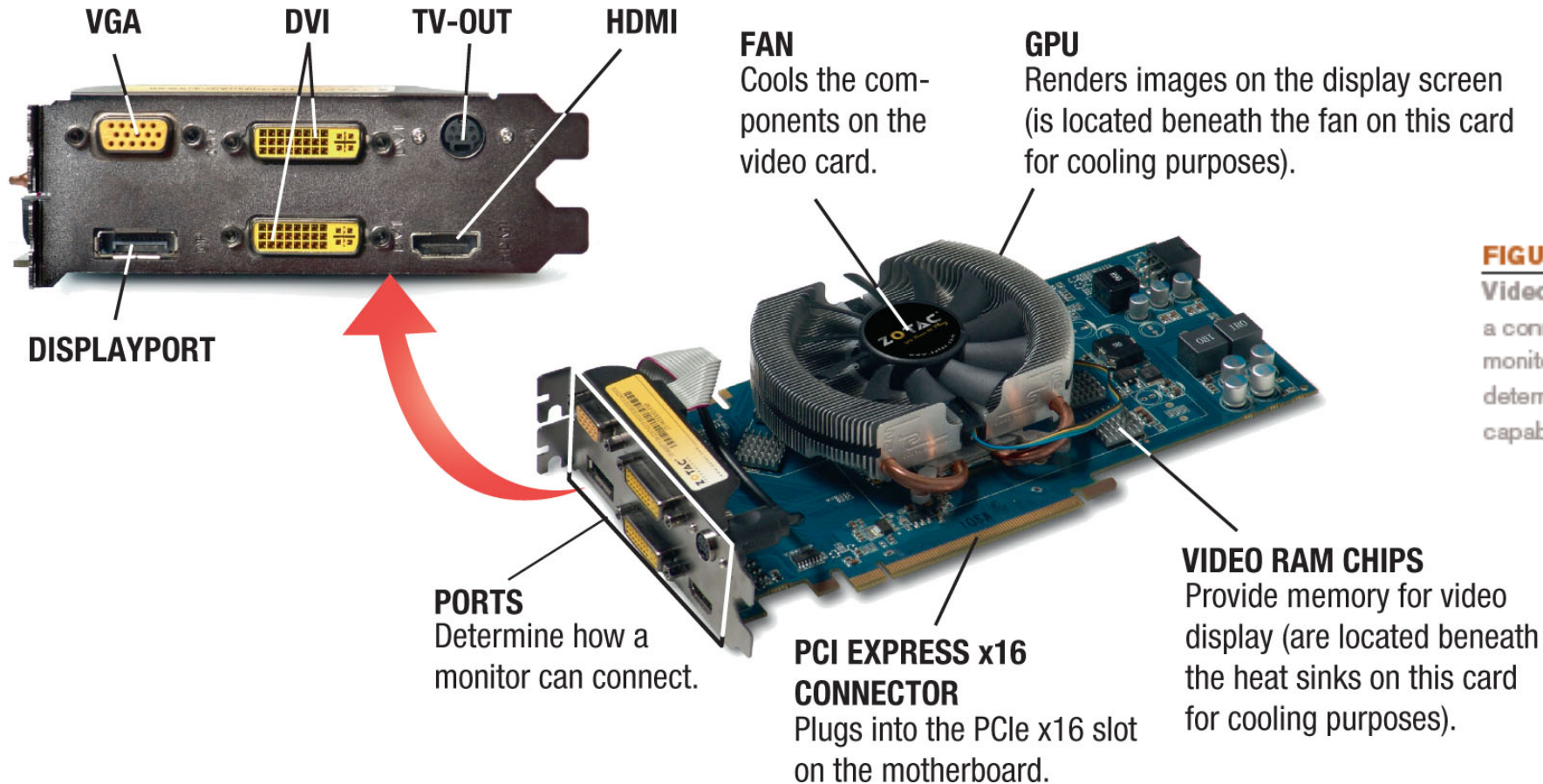


FIGURE 4-28

Video cards. Provide a connection to a monitor, as well as determine video capabilities.

Courtesy ZOTAC

Display Devices

- Wired vs. Wireless Displays
 - Most monitors are physically connected to the system via a cable (wired)
 - Wireless displays connect using a wireless network connection (Wi-Fi, Bluetooth)
- 2D vs. 3D
 - Most displays are 2D
 - 3D displays use filters, prisms, and multiple lenses to create the 3D effects

Display Devices

- Wearable Displays
 - Project images from a mobile device to a display screen built into glasses
- Touch and Gesture Capabilities
 - Kiosks and portable gaming devices
 - Mobile phones and portable digital media players

FIGURE 4-30
Wearable displays.



Display Devices

- Flat Panel Display Technologies
 - Liquid Crystal Displays (LCDs)
 - Use charged liquid crystals between sheets of glass or plastic
 - Requires backlighting
 - Light Emitting Diode Displays (LEDs)
 - Used in alarm clocks, Christmas lights, car headlights, and other consumer products
 - Currently used to backlight LCD panels

Display Devices

- Organic Light Emitting Diode Displays (OLED)
 - Use layers of organic material
 - Emit visible light when current is applied
 - Are thinner than LCDs
 - Have brighter and sharper images than LCD
 - Incorporated into many digital cameras, mobile phones, and portable digital media players

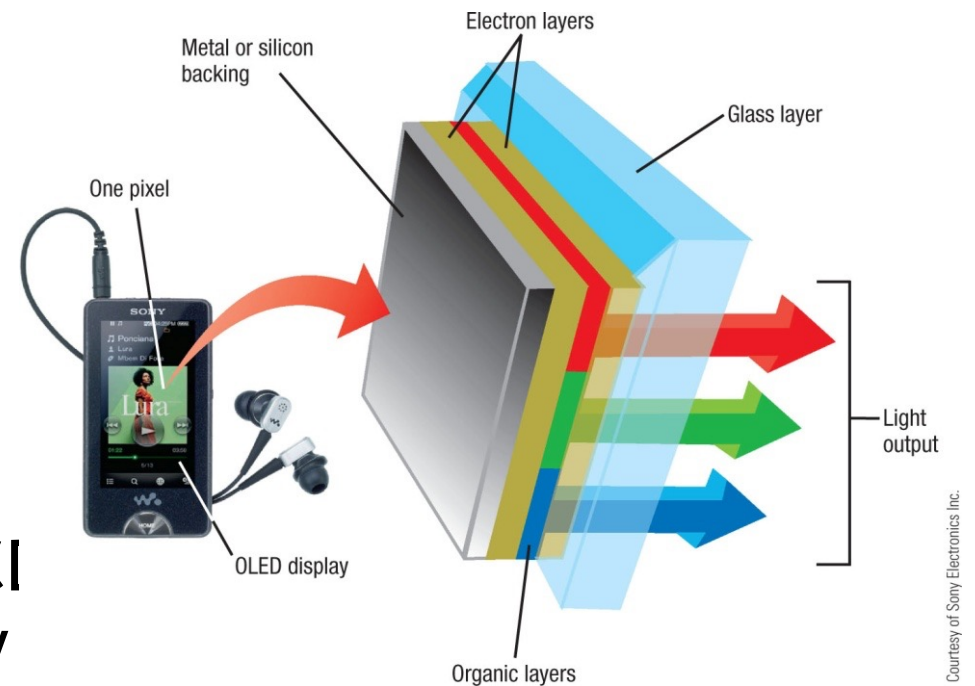


FIGURE 4-31
How OLED displays work. Each pixel on an OLED display emits light in the necessary color.

Courtesy of Sony Electronics Inc.

Display Devices

- Special Types of OLEDs
 - FOLED (Flexible OLED)
 - OLED displays built on flexible surfaces such as plastic or metal foil
 - TOLED (Transparent OLED)
 - Displays are transparent
 - Emit light toward top and bottom of display surface
 - PHOLED (Phosphorescent OLED)
 - Process that converts electrical energy into light rather than heat

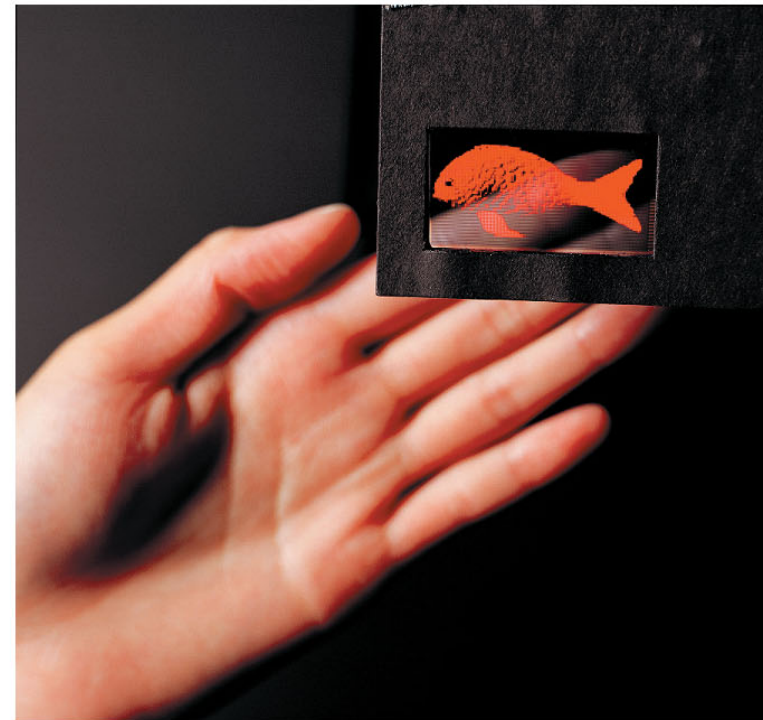
Display Devices

FIGURE 4-32
Special types
of OLEDs.



FOLEDs

Used to create flexible displays on plastic or another type of flexible material.



TOLEDs

Used to create transparent displays.

Courtesy of Universal Display Corporation

Display Devices

- Interferometric Modulator (IMOD) Displays
 - Essentially a complex mirror that uses external light to display images
 - Designed initially for mobile phones and portable devices
 - Images are bright and clear, even in sunlight
- Plasma Displays
 - Use layers of gas to display images
 - Most often used on large displays
 - Being replaced by LCDs



Courtesy of QUALCOMM MEMS Technologies, Inc.

FIGURE 4-33
An IMOD display is bright and readable, even in direct sunlight.

Display Devices

- Data and Multimedia Projectors
 - Display devices that projects all computer output to a wall or projection screen
 - Found in classrooms and conference rooms
 - Can be wireless or integrated into devices
 - Some contain an iPod dock
 - Pico projectors are pocket-size and connect mobile and portable devices
 - Hologram projectors used to display 3D images
 - Tiled projectors use multiple projectors to display content from a single source

Display Devices

FIGURE 4-34
Data projectors.

Courtesy of ViewSonic Corporation



CONVENTIONAL DATA PROJECTORS

Frequently used for both business and classroom presentations.

Courtesy Microvision, Inc.



PICO PROJECTORS

Images from a mobile device (such as the mobile phone shown here) are projected onto any surface.

Courtesy of Scalable Display Technologies



TILED PROJECTORS

Project a single seamless image using multiple projectors.

Printers

- Printer Characteristics
 - Printing Technology
 - Impact Printers (Dot Matrix)
 - Print mechanism actually strikes the paper to transfer ink
 - Used to produce multipart forms
 - Non-impact Printers (Ink-Jet and Laser)
 - Use liquid ink or toner
 - Produce higher quality images
 - Much quieter than impact printers



Courtesy InfoPrint Solutions Company

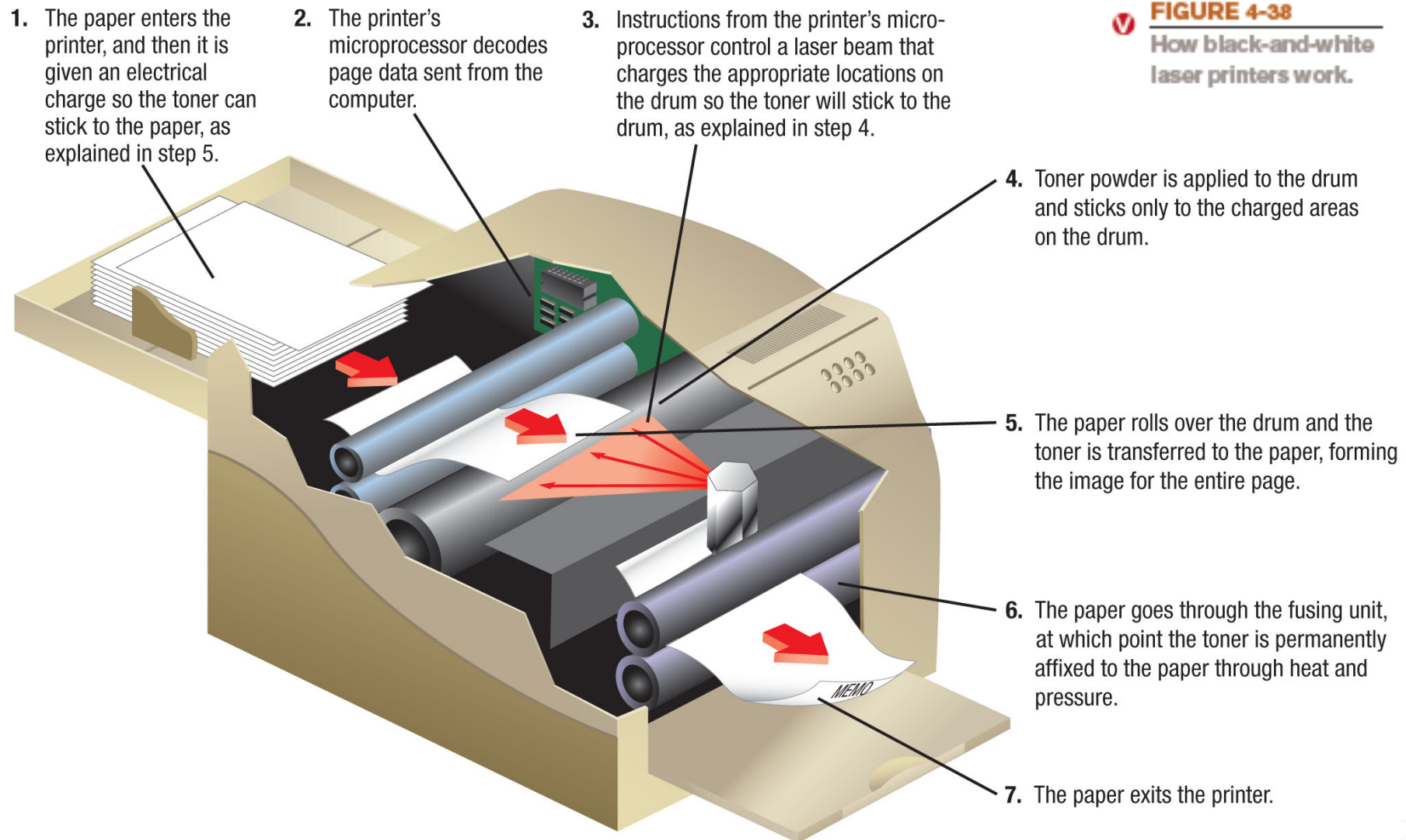
FIGURE 4-35

Dot-matrix printers. Dot-matrix printers are impact printers; today they are typically high-speed printers used in manufacturing, shipping, or similar applications.

Printers

- Color vs. Black and White
 - Colors printers use magenta, cyan, yellow, and black ink
- Personal vs. Network Printers
 - Personal printers connect directly to a single computer
 - Network printers connect directly to a network so they can be used by all authorized network users
- Print Resolution
 - Measured in dpi (dots per inch)
 - More dots per inch results in higher quality output
 - 300 dpi for general purpose printing; 1,200 dpi for photographs; 2,400 dpi for professional applications

Printers



Printers

- Print Speed
 - Measured in pages per minute (PPM)
 - Personal printers - 20-35 ppm
 - Network printers - 30 to 65 ppm
- Connection Options
 - USB connection most common
- Multifunction Capabilities
 - Copy, fax, scan, print
 - All-in-ones



FIGURE 4-37
A multifunction
device (MFD).

Courtesy Epson America

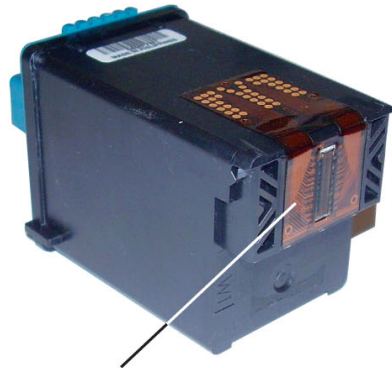
Printers

- Laser Printers
 - Use toner powder and technology similar to that of a photocopier to produce images on paper
 - The standard for business documents
 - Print one entire page at a time
 - Generally faster and have better quality output than ink-jet printers
 - Can be black and white or color
 - Common print resolution for laser printers is between 600 and 2,400 dpi
 - Use toner cartridges

Printers

- Ink-Jet Printers
 - Sprays droplets of ink to produce images on paper
 - Use ink cartridges
 - Usually print in color
 - Often the choice for home use
 - Relatively inexpensive with good-quality output
 - Print more slowly than laser printers
 - Newer printers with full width printheads are much faster
 - Potential applications for the future
 - Dispensing liquid metal, aromas, computer chips and other circuitry, “printing” human tissue

Printers



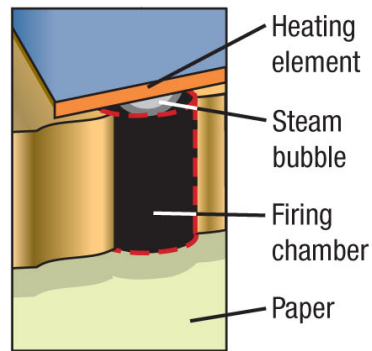
Each ink cartridge is made up of multiple tiny ink-filled firing chambers; to print images, the appropriate color ink is ejected through the appropriate firing chamber.



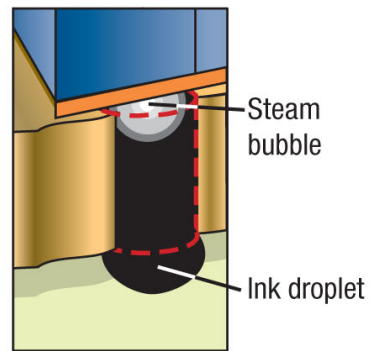
Courtesy Epson America

INK-JET PRINTER

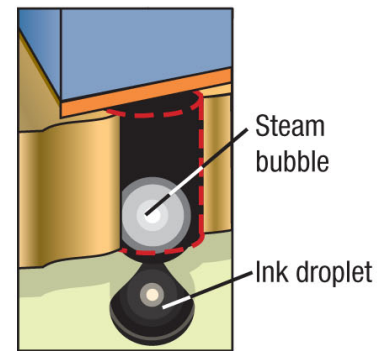
FIGURE 4-39
How ink-jet printers work.



1. A heating element makes the ink boil, which causes a steam bubble to form.



2. As the steam bubble expands, it pushes ink through the firing chamber.



3. The ink droplet is ejected onto the paper and the steam bubble collapses, pulling more ink into the firing chamber.

Printers

- Special Purpose Printers
 - Photo Printers
 - Barcode, label, and postage printers
 - Portable printers
 - Plotters and wide-format ink-jet print
 - 3D printers

FIGURE 4-40
Special-purpose
printers.

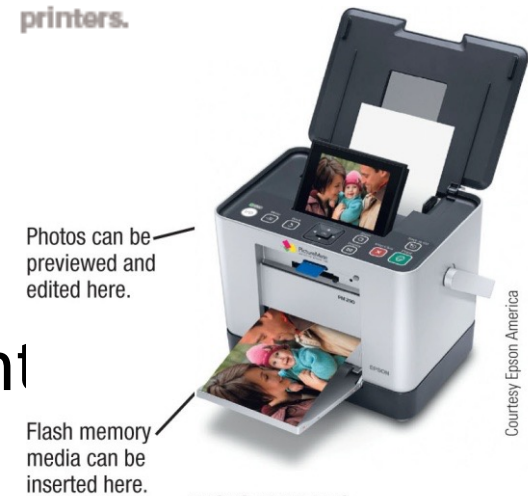


PHOTO PRINTERS
Used to print digital photographs in a variety of sizes.



BARCODE PRINTERS
Used to print barcoded labels. Some printers can also program RFID tags when they are embedded inside the barcoded labels.



PORTABLE PRINTERS
Used to print items (such as shelf labels shown here) while on the go.



INTEGRATED PRINTERS
This printer uses no ink and is integrated into the digital camera to print digital photographs.



WIDE-FORMAT PRINTERS
Used for printouts that are too big for a standard-sized printer.



3D PRINTERS
Used to print items (such as plastic parts or models) in 3D.

Audio Output

- Audio Output
 - Voice, music, and other audible sounds
 - Common audio output devices
 - Computer speakers
 - iPod/MP3 dock and integrated speakers
 - Headphones and headsets
 - Earphones and earbuds



Courtesy of Altec Lansing

COMPUTER SPEAKERS

Used to output sound from a computer.



Courtesy NordicTrack

IPOD/MP3 DOCK

Used to output sound from a portable digital media player.



AXL/Shutterstock.com

HEADSETS

Used when both voice input and audio output are required.

FIGURE 4-41
Audio output
devices.

Quick Quiz

1. Which of the following types of display devices should have the largest footprint (the amount of room taken up on a desk)?
 - a. CRT monitor
 - b. OLED display
 - c. LCD display
2. True or False: Laser printers can only print in black and white.
3. _____ printers form images with drops of liquid ink.

Answers:

1) a; 2) False; 3) Ink-jet printers

Summary

- Keyboards
- Pointing and Touch Devices
- Scanners, Readers, and Digital Cameras
- Audio Input
- Display Devices
- Printers
- Audio Output