ANDIJAN STATE PEDAGOGICAL INSTITUTE

Lecture materials · 2026–2027 academic year

SUBJECT

Information Systems and Digital Technologies

Lecture 5 · Input & Output Devices

Part 1 of 2 · 2 hours

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LECTURE 05 · 2 HOURS · PART 1/2

FUNDAMENTALS OF COMPUTERS · CHAPTER 4

Input Devices

How people, paper and pictures get translated into signals a computer can act on



A Computer Science review deck for classroom use

What We'll Cover

Seven families of input device, from the everyday to the specialised

Keyboard

Typing data, text and commands with dedicated groups of keys

Digital Camera

Capturing photos and video electronically

Pointing Devices

Mouse, trackball, light pen, joystick and touchscreen

Voice Recognition

Converting spoken words into machine-readable signals

Scanning Devices

Turning paper documents and photos into digital bit maps

Media Input Devices

Microphone, webcam and graphics tablet

Optical Recognition

OCR, OMR, MICR and bar codes that read printed marks

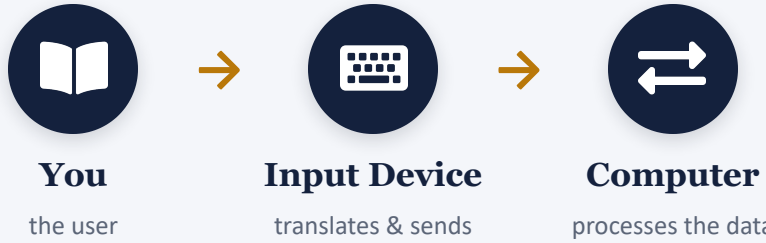
16+

named input devices covered in this chapter

What Is an Input Device?

An input device is an electromechanical device that supplies data to a computer for storage and further processing. It acts as the interface between the computer and the user, translating what a person enters into a machine-readable form before handing it to the processing unit for execution.

The interface, in three steps



Input can take many forms

- Numeric data
- Text commands
- Graphics
- Video
- Audio

Manual Input

The user types on a keyboard or clicks with a mouse — data is entered directly by hand.

Direct-from-Document Input

Devices such as scanners read data straight from an existing document instead of retyping it.

The Keyboard

The most commonly used input device

We use a keyboard to type data and text, and to execute commands. Keyboards are attached to the system by cable, although wireless, battery-powered keyboards are now common too. Manufacturers also add extra buttons for specialised jobs — which is how we get multimedia keyboards and gaming keyboards, classified by the additional keys they carry.

Wired | **Wireless (battery)** | **Multimedia** | **Gaming**

~100

keys on a standard keyboard

Popularly arranged in the QWERTY layout, the same style used by traditional typewriters.

Every key press sends a distinct electrical signal to the processor, one code per key.

Anatomy of a Keyboard

Five groups of keys, each with its own job

Alphanumeric Keys

- Letters and numbers
- Arranged in the QWERTY style used by typewriters

Function Keys

- A row along the top edge
- Trigger specific tasks — e.g. search a file, refresh a page

Central Keys

- Arrow keys move the cursor
- Modifier keys: SHIFT, ALT and CTRL change what other keys do

Numeric Keypad

- Sits on the right of the board
- 10 digits plus operators, like a calculator's pad

Special Purpose Keys

- Escape, Insert, Delete, Print Screen, Pause, Tab, Spacebar
- Each performs one dedicated operation

Why it matters

Knowing the five groups makes it easy to predict what any unfamiliar key does on sight.

Pointing Devices

Moving the cursor to point, select and drag on a GUI

Pointing devices move the cursor to a particular spot on screen so we can select icons, menus and windows in a Graphical User Interface. We can reposition an object simply by pointing at it and dragging it to where we want it — no typing required.

Mouse

2D cursor control for click, select, drag

Trackball

A ball in a socket, rolled by hand

Light Pen

Electro-optical pen for the screen

Joystick

A stick and buttons for gaming & CAD

Touchscreen

Direct entry by touching the display

The next four slides look at each of these in turn, starting with the mouse.

The Mouse

A small hand-held device that controls 2D cursor movement

Mechanical Mouse

- A rubber-coated ball inside rolls as you move the mouse across a surface
- Left button — selects icons, folders and text (used most often)
- Right button — opens the shortcut menu
- Scroll button — scrolls the screen up and down

Optical Mouse

- No moving ball — reflected light tracks the movement instead
- LEDs (Light Emitting Diodes) illuminate the surface underneath
- An optical sensor reads the reflected light
- A DSP (Digital Signal Processor) turns that reading into cursor movement

Both report a two-dimensional cursor position to the GUI — they simply sense the movement in different ways: a rolling ball versus reflected light.

Trackball & Light Pen

Two more ways to move the cursor without a mouse pad

Trackball

- A ball sits in a socket; rolling it with a finger or thumb moves the cursor
- Sensors inside the socket detect the movement of the ball
- Small trackballs suit portable computers; large ones suit desktops and CAD work
- Can sit on a desk, a mouse pad, or even in your hand
- *Also used as a game controller — e.g. Centipede, Golden Tee, Marble Madness*

Light Pen

- An electro-optical pen used to select objects directly on the display
- Connects to the Visual Display Unit (VDU)
- A light-sensitive diode in the tip generates a pulse when it touches the screen, telling the processor exactly where it is pointing
- Offers all the capabilities of a mouse, with no pad or flat surface needed — useful when desk space is tight

Neither needs a flat mouse pad — the trackball rolls in place, while the light pen points and touches the glass directly.

The Joystick

A stick and buttons for pointing in any direction

A joystick usually combines a stick with one or more buttons. Moving the stick points the cursor in a direction, and it keeps pointing that way until it is returned to the vertical centre. A trigger button fires an action — like shooting in a game. Early joysticks gave only 2D movement; today's can provide 3D movement as well.

Three types of control

Glide

Free movement in any direction — left, right, up, down

Direct

Free movement in any direction — left, right, up, down

Digital

Movement limited to a fixed set of directions

Used in

Computer games | **CAD systems** | **Industrial applications**

The trigger button

A dedicated button fires an in-program action — the classic example is firing a weapon in a game sequence.

Touchscreen Technologies

Entering text, pictures and images by touching the display directly

Found in cell phones, ATMs, PDAs and games — no keyboard or mouse required.

Surface Wave

- Ultrasonic waves travel across the panel
- A touch absorbs the waves at that point
- The controller reads the absorption to find the location
- **Affected by dust and water**

Capacitive

- An indium tin oxide coating carries a continuous electric charge
- Circuits at each corner sense the small charge a touch absorbs
- That reading is sent to the controller for processing
- **Not damaged by dust or liquids**

Resistive

- Several thin, electrically conductive layers sit with a gap between them
- A touch presses the layers together, changing the current
- The change in current is passed to the controller
- **Not damaged by dust or water**

Capacitive and resistive panels both shrug off dust and water; surface wave is the one technology that does not.

Scanning Devices

Electronically capturing text and images as computer-readable data

A scanning device converts an image or block of text into digital data — a grid of 0s and 1s called a bit map. Scanners are told apart from one another using three characteristics:

Resolution

- Closeness of the pixels in the bit map
- Ranges from 72 to 600 dpi depending on bit depth
- Bit depth = bits used per pixel

Size

- Small scanners handle about 2–5 inches of document
- Large scanners handle documents up to 40 inches

Scanning Technology

- CCD (Charged Coupled Device) arrays sense changing light frequency
- PMT (Photo Multiplier Tubes) detect weak light signals via a photocathode

Together, these three characteristics are what separate an everyday flatbed scanner from a professional, high-end one.

Four Types of Scanners

Categorised by resolution, size and scanning technology

Hand-held Scanner

- Also called a half-page scanner — scans up to about 5 inches at a time
- Small and comparatively inexpensive
- Mainly used to read bar-code labels
- Contact type (light pen tip on the label) or non-contact type (gun points at the label)

Flatbed Scanner

- A glass pane with xenon light and a CCD array of red, green and blue filters underneath
- Document is placed face-down; scans left to right, line by line
- Standard size starts at 8.5" × 11" (letter size)
- Optical resolution up to 5,500 dpi — great for slides and photos

Drum Scanner

- A large rotating drum, using PMT rather than CCD technology
- Very high resolution: 8,000–11,000 dpi — but slow and expensive
- Scans up to about 8" × 10" (some up to 11" × 24")
- Aperture and sample area are both adjustable

Slide Scanner

- Also called a film scanner — scans slides and film negatives
- A stepper motor and CCD sensor move across the film
- Handles up to 35 slides in one batch
- Optical resolution of 4,000–4,800 dpi

Optical Resolution, Compared

Maximum optical resolution by scanner type (dots per inch)



Slide Scanner

4,000 – 4,800 dpi

Film negatives & slides

Flatbed Scanner

up to 5,500 dpi

Everyday documents & photos

Drum Scanner

8,000 – 11,000 dpi

Professional, high-end work

Optical Recognition Devices

Reading printed marks so nobody has to retype them

Optical recognition devices recognise characters optically, using an optical scanner to capture the data. Unlike a keyboard, nothing is entered by pressing keys — which saves a great deal of time compared with typing everything in by hand.

OCR

Optical Character Recognition

Reads printed characters and turns them into editable text

OMR

Optical Mark Recognition

Detects marks in predefined boxes, like exam answer sheets

MICR

Magnetic Ink Character Recognition

Reads characters printed in magnetic ink, used on cheques

Bar Code Reader

Vertical-line product codes

Reads the striped codes used on retail packaging

OCR — Optical Character Recognition

Turning a printed page into an editable document

OCR devices scan a document, recognise its individual characters, and convert them into an editable form — distinguishing dark areas from light areas on the page. The scanned text can then be edited and formatted like any other computer document.

Three components

Image Scanner

Captures the text image to be recognised

OCR Software & Hardware

Analyses the image and recognises characters by shape

Output Interface

Passes the recognised text out to the wider system

Detects patterns of reflected light using photoelectric cells, then converts them into character code. Popular in telebanking and credit-card processing.

OMR — Optical Mark Recognition

Reading marks in predefined boxes, not the whole page

OMR devices read data from marked fields using an OMR reader, a special sensor that recognises marks in predefined box areas. Rather than scanning the entire sheet, the OMR device analyses only the darkened boxes to check whether each one is marked.

10,000

documents scanned per hour

Fast and accurate — built for scoring stacks of multiple-choice sheets.

Used for

- Question papers
- Enrolment forms
- Registration forms
- Employee payroll

Students mark the correct answer in the box with dark pencil or ink; the device checks only whether that spot is filled in.

MICR — Magnetic Ink Character Recognition

Reading the numbers printed in magnetic ink on a cheque

MICR devices recognise characters written with magnetic ink containing iron oxide particles. Developed specifically for banking, they process a cheque, identify the numeric characters printed on it — the cheque number and the bank and branch code — and store that data on disk. The characters remain human-readable, and MICR devices can still recognise them even if the cheque has become crumpled or dirty.

What gets read off the cheque

The cheque number, the bank code and the branch code — all printed along the bottom edge in magnetic ink.

Built-in security

A colour photocopy of a cheque simply will not respond to a MICR reader — the magnetic ink cannot be reproduced by an ordinary copier. That gives banks a built-in defence against illegal copying.

How it works

The cheque feeds into the MICR scanner, whose MICR toner produces a magnetic charge to read the line of characters — quickly, which saves considerable processing time for the bank.

Bar Code Reader

Vertical lines of different widths, read at the checkout

A bar code is a computer-readable code made of vertical bars of differing widths. Bar code readers are used to label items in supermarkets and retail stores, and to number books in a library.

From bars to data: how a scan travels

Scanner

Directs a light beam over the printed bar code

Sensor

Reads the light reflected back from the bars

Decoder

Converts the reflected pattern into numbers or letters

Cable → Computer

Sends the decoded data on for processing

Physically, a reader is just three parts working together: a scanner, a decoder and a cable to the computer — light energy becomes electrical energy, then becomes data.

Digital Camera

A handheld device with a built-in computer for capturing images

From light to a digital image



Light Through the Lens

Pressing the shutter lets image light enter



CCD Photosites

A microchip of light-sensitive diodes stores the light



Analog Electrons

Photosites convert light into electric charges



A/D Converter

Electrons become the final digital image

Four defining features

- Captures and stores thousands of images on a single memory chip
- Can edit and delete images directly on the device
- Records video clips complete with sound
- Plays back the clip you just recorded on the camera's own screen

Picture quality tracks resolution

The higher a digital camera's resolution, the better the image quality it can produce.

A digital camera is really a small, purpose-built computer — sensor, processor and storage all built into one handheld body.

Types of Digital Cameras

Four designs built for different jobs

Video Cameras

- Capture an image as horizontal lines, scanned top to bottom
- Professional video cameras — used in film studios
- Camcorders — also record audio, with an LCD screen and built-in recorder

Compact Digital Cameras

- Small and easy to carry
- Fewer advanced capture features
- Lower image quality than other types
- Store images in JPEG format

Digital SLR Cameras

- Use a mirror and a pentaprism
- Light reflects off the mirror, through the prism, to the eyepiece
- Live preview lets you check the shot before you take it

Line-scan Cameras

- Built around an array of image sensors
- Capture and scan an image line by line
- Very fast capture with high resolution

Voice Recognition System

It identifies who is speaking, not what they are saying

A voice recognition system records a person’s voice, transforms it into electrical signals, and converts those into machine-readable code. It only recognises the identity of the speaker, not the content of the speech.

Template Matching

Speaker-dependent

- The user speaks a word or phrase into the microphone
- An A/D converter turns it into machine-readable code
- Voice recognition software compares it against stored voice templates in the database
- *Limitation: only recognises the limited vocabulary used during training*

Feature Analysis

Speaker-independent

- Does not match against a predefined template
- Processes the voice input using Fourier analysis, which changes its frequency
- The result is matched against stored templates to find similar features
- *Limitation: struggles with accent, volume, pitch and inflection*

Lets people work with a computer hands-free — used for dictation and training air-traffic controllers, and especially valuable for users who are visually impaired.

Sensors & Media Input Devices

Detecting physical signals, and capturing sound, video and drawings

Data Acquisition Sensors

Detect and measure physical quantities — like heat and temperature — and convert them into electrical signals for a data acquisition system. Typically portable, battery-operated and simple to use.

Media input devices

Microphone

- Converts sound waves into electrical signals (voltage or current)
- Also called a transducer
- Cable kept under 10 feet to avoid noise
- Used in radios, tape recorders, telephones

Webcam

- Attached to a computer to record video and images
- Enables live video conferencing over the internet
- Quality depends on frame rate and resolution

Graphics Tablet

- A digitising pen (also called a stylus) plus an electronic tablet
- Pen movement becomes digital signals, shown on the display — not the tablet
- More accurate than a mouse; common in CAD and technical drawing

Chapter Recap

Every device from this chapter, grouped by family

Keyboard

- Alphanumeric
- Function keys
- Central keys
- Numeric keypad

Pointing Devices

- Mouse
- Trackball
- Light pen
- Joystick
- Touchscreen

Scanning Devices

- Hand-held
- Flatbed
- Drum
- Slide

Optical Recognition

- OCR
- OMR
- MICR
- Bar code reader

Digital Camera

- Video camera
- Compact
- DSLR
- Line-scan

Voice Recognition

- Template matching
- Feature analysis

Media Input

- Microphone
- Webcam
- Graphics tablet
- Sensors

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device families, one exam’s worth of vocabulary

Study Smart: the Companion Review App

The same chapter, in an interactive practice tool

Flashcards

Flip through every key term and its definition

Quiz

Multiple-choice questions with instant feedback

Matching

Drag each device to its real-world application

Fill-in-the-Blank

Type the missing term from memory

28 key terms

21 quiz questions

8 matching pairs

25 terminology challenges

Let's Discuss

Three questions to open the conversation

A light pen and a mouse can both point and click — so why do VDU-based systems still favour the light pen for direct on-screen selection?

Why does a colour photocopy of a cheque fail to fool a MICR reader, and what does that tell us about what MICR actually reads?

Capacitive and resistive touchscreens both resist dust and water — so what actually distinguishes one from the other?