



USE OF LIBRARY, STUDY SKILLS, AND INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

Edited by:
Grace A. Ajuwon, PhD

CHAPTER 11

INPUT, STORAGE, AND OUTPUT DEVICES

Patrick Agwu

Input Devices

An input device is used to feed data into computers. They are capable of converting data into a form which can be recognized by computer. These are devices used to accept data and instructions from the user. Computers receive inputs (instructions and data) through input devices. The input device lets you communicate with a computer. You can use input devices to enter information and issue commands.

There are different input devices, namely: i. Keyboard ii. Mouse iii. Trackball iv. Joystick v. Scanner vi. Light pen vii. Bar Code Reader viii. Optical Character Recognition (OCR) ix. Optical Mark Reader (OMR) x. Magnetic Ink Character Recognition (MICR) etc.

1. Keyboard: The most common input device is the keyboard. It is used to enter both numerical and character-type data. It is like a mechanical typewriter with *alphanumeric* and *special keys, punctuation keys, and functional keys* to perform specific. The keyboards contain 101 keys or 104 keys. The keyboard detects the key pressed and generates the corresponding ASCII codes which can be recognized by the computer.

Types of Keyboards

a. Standard keyboard: The standard keyboards have their basic layout. The average number of keys on a regular keyboard is 105/108; QWERTY keyboards are the most common and have the six alphabets Q, W, E, R, T, and Y in the first row.

b. Ergonomics: It refers to the study of methods that can reduce stress on muscles to avoid repetitive strain injury. It mostly deals with optimizing posture and technique while working, so the work can be carried out most easily.

c. Wireless keyboard: It is a keyboard that does not need to connect to the computer via a wire. This makes the use of the keyboard very convenient and comfortable. Wireless keyboard uses Bluetooth, Infrared (IR) to connect to the computer.

d. Virtual keyboard: It is a software device that leads to use input data just like hardware keyboard. They open as an application and can be controlled by a mouse or wire touch screen.

e. Compact keyboard: These keyboards are slim and usually do not have the numerical keypad that is present on the right side of the keyboard. These are typically used in laptops.

2. MOUSE: This is an input device that controls the movement of the cursor on the display screen. MOUSE stands for “**M**echanically **O**perated **U**ser **S**erial **E**ngine”. The Mouse is used as a pointing device. It is a small device; you can roll/navigate along a flat surface. A mouse has a small ball/IR ray is kept inside and touches the pad through a hole at the bottom of the mouse.

There are two types of MOUSE: Mechanical and Optical

a. Mechanical: This mouse has a small rubber ball underneath that moves against two rollers as it passes across a flat surface.

b. Optical: This mouse is more accurate and has no moving parts. It uses a laser to detect movement.

3. Joystick: This is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. The joystick can be moved in all four directions. The function of the joystick is like that of a mouse however, it is mainly used in playing computer games.

Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles, surveillance cameras and zero turning radius lawn mowers.

4. Scanner: The scanner is an input device which works more like a photocopy machine. It is used when some information is available on a paper, and it is to be transferred to the computer for further manipulation. The scanner captures images from the source which are then converted into the digital form.

5. Optical Mark Reading and Recognition (OMR): Optical Mark Reader is a device that reads pencil marks and converts them into computer processed form. Special pre-printed forms are designed with boxes which can be marked with a dark pencil or ink. Such documents are read by a reader, which transcribes the marks into electrical pulses which are transmitted to the computer. They are widely used in applications like objective type answer papers evaluation in which large number of candidates appear etc.

6. Optical Character Recognition (OCR): The main use of these devices is to recognize alphabetic and numeric characters printed on paper. The OCR technique permits the direct reading of any printed character without any special ink. With OCR, a user can scan a page from a book and the computer will recognize the characters in the page as letters and punctuations marks and stores and can be edited using a word processor the size (width, height and depth) of the scanned. OCRs are used in applications such as Credit Card billing and reading of pin code numbers in large post offices to sort mail geographically.

7. Magnetic Ink Character Recognition (MICR): MICR is a form of character recognition that reads the text printed with magnetic charged ink. The shapes of the characters by sensing the magnetic charge in the ink and translates these shapes into computer processed format. MICR is widely used by banks to process cheques.

The cheque can be read using a special input unit, which recognizes magnetic ink characters. This method eliminates the manual errors. It also saves time and ensures security and accuracy of data.

Output Devices

- When the data and instructions are fed into the computer and processed the next step is to get the desired output.
- This output may be displayed on the monitor or printed on the computer.
- The output displayed on the monitor is called **soft copy** output.
- The output produced on a computer is called **hard copy** output.

Note: The device that displays output to the user is called the **output device**.

1. Monitor: It is a commonly used output device sometimes called a display screen/VDU. Monitors connected to the computer are like a television set. Monitor display image and text. The smallest dot that can be displayed is called a **pixel**. The resolution of the monitor determines the quality of the display. Some popular resolutions are 640X480 pixels, 800X600 pixels, and 1024X768 pixels. The different size of the monitor is measured diagonally maybe 12”, 14”, 17”, 19”, 21”. The different types of monitors: CRT (Cathode Ray Tube), LCD (Liquid Crystal Display), TFT (Thin Film Transistors), LED (Light Emitting Diode)

2. Printer: Printer is an output device that prints text or images on paper. By printing you create a **‘hard copy’** of data. There are different kinds of printers, which vary in their

speed and print quality. The two main types of printers namely. Impact Printers and Non-Impact Printers.

3. Plotter: Plotter is an output device that draws shapes on paper based on commands from a computer. Plotter differs from printers in that they draw lines using a pen. As a result, they can produce continuous lines, whereas printers can only stimulate lines by printing a closely spaced series of dots. Multicolour plotters use different coloured pens to draw different colours. Plotters are more expensive than printers. They are used in engineering applications.

4. Speakers: With speakers, the sound signals from analogue/ digital are converted into audible frequency in the speakers and produce voice output [audio data]. Using speakers with speech synthesizer software, the computer can provide voice output. Voice output has become very common in many places like airlines, banks, automatic telephone inquiry systems etc.

5. Memory: is an essential component of any digital computer. It is a storage device. It stores programs and data, required by the CPU, and the results generated after processing. This storage enables us to use the stored data in the future. There are two kinds of memory that are commonly used in computers:

1. Primary Memory (Semi-Conductor Memory)
2. Secondary Memory (Magnetic Memory)

The storage capacity of a computer is measured in terms of **Bytes**. One byte includes a total of 8 individual units called **bits**. One bit can store either a 0 or 1 in it. The table below gives the storage capacities.

Unit	Symbol	Equal to
Byte	B	8 Bits
Kilobyte	KB	1,024 B
Megabyte	MB	1,024 KB
Gigabyte	GB	1,024 MB
Terabyte	TB	1,024 GB
Petabyte	PB	1,024 TB
Exabyte	EB	1,024 PB
Zettabyte	ZB	1,024 EB

Yottabyte	YB	1,024 ZB
-----------	----	----------

Primary Memory

The primary memory is the main memory of the computer.

- i. It stores the programs and data, which are currently needed by the CPU.
- ii. The size of the main memory is comparatively much smaller than that of the secondary memory because of its high cost.
- iii. The CPU communicates directly only with the main memory.
- iv. As the CPU works at very high speed, its matching memory must be very fast.
- v. Only primary memory devices can provide the matching speed.
- vi. RAM and ROMs are used as the main memory of the computer.
- vii. Primary memory is of two types. RAM (Random Access Memory) and ROM (Read Only Memory)

Random Access Memory (RAM)

- RAM is also called as the main memory of a computer.
- This is really the main store and is the place where the program gets stored temporary.
- When the CPU runs a program, it fetches the program instructions from the RAM and carries them out.
- If the CPU needs to store the results of the calculations it can store them in RAM.
- When we switch off a computer, whatever is stored in the RAM gets erased.
- It is a **volatile** form of memory.
- Types of RAMS
 - EDO RAM (Extended data output RAM)
 - SRAM (Static RAM)
- DDR RAM (Double Data Rate RAM)

EDO RAM:

- EDO RAM stands for Extended Data Output RAM.
- It improves the time to read from memory on faster microprocessor such as Intel Pentium.
- EDO RAM was initially optimized for the 66 MHz Pentium

SRAM:

- SRAM stands for Static Random Access Memory.
- It is type of semiconductor memory that uses bi-stable latching circuitry to store each bit.
- Unlike dynamic RAM (DRAM), which stores bits in cells consisting of a capacitor and a transistor, SRAM does not have to be periodically refreshed.

DDR RAM:

- DDRRAM stands for Double Data Rate Synchronous Dynamic Random Access Memory.
- It is a type of very fast computer memory.
- It is based on the same architecture as SDRAM but uses the clock signal differently to transfer twice the data in the same amount of time.

Read Only Memory (ROM)

- ROM stands for “**Read Only memory**”.
- The information is pre-recorded into to ROM chip at manufacturing time.
- Once data has been written into a ROM Chip, it cannot be erased but you can read it.
- When we switch OFF the computer, the contents of ROM are not erased, but remain stored permanently.
- ROM is **non-volatile memory**.
- ROM stores critical programs such as the programs that boot the computer.
- Types of ROM: PROM (Programmable ROM), EPROM (Erasable Programmable ROM), and EEPROM (Electrically Erasable Programmable ROM).
- **Programmable ROM:** It is a memory on which data can be written only once. A variation of the PROM chip that is not burnt at the manufacturing time but can be programmed using PROM programmer or a PROM burner.
- **Erasable Programmable ROM:** The information can be erased and re-programmed using a special PROM – programmer. AN EPROM differs from a PROM in that PROM can

be written only once and cannot be erased. But ultraviolet light is used to erase the contents of EPROM.

- **Electrically Erasable Programmable ROM:** This is equivalent to EPROM but does not require ultraviolet light to erase its content. It can be erased by exposing it to an electrical charge.

Difference between RAM and ROM

RAM	ROM
RAM stands for Random Access Memory	ROM stands for Read-Only Memory
RAM allows the computer to read data quickly to run applications. It allows reading and writing.	ROM stores the program required to initially boot the computer. It only allows reading.
RAM is volatile i.e. its contents are lost when the device is powered off.	It is non-volatile i.e. its contents are retained even when the device is powered off.
The two main types of RAMS are static RAM and dynamic RAM.	The types of ROM include PROM, EPROM and EEPROM.

Secondary Memory

Since the storage capacity of the primary memory is not very large, it cannot hold a large amount of data, including programs, which may be needed for processing. Thus, secondary storage devices are necessary. The secondary memory is used as auxiliary memory. The secondary memory is used for bulk storage or mass storage of programs, data, and other information. It has a much larger capacity than main memory. The secondary memory retains the information once stored on it. Magnetic memory such as Hard Disk Drive (HDD), Compact Disk, Pen Drive, Memory cards is the most used secondary memory in the computer. The average time required to reach a storage location and obtain its contents is called its access time.

Magnetic Disks:

- Magnetic disks are thin circular plastic plates on which some magnetic material is coated.
- Magnetic disks come in various sizes and materials.

- They use the properties of magnetism to store the data on a magnetic surface.
- A disk pack normally consists of such disks mounted on a central shaft.
- The central shaft rotates at speeds of about 7200 revolutions per minute (RPM).
- In a disk plate information is stored on both surfaces. The surface is further divided into several invisible concentric circles called as tracks.
- The tracks are further divided into various sections called sectors.
- To store information, it is necessary for us to identify the track and sector where it must be stored.
- The stored information can be read any number of times without affecting the stored data. But when new data is written it erases the previously written data.
- Two types of magnetic disks are: Hard Disk and Floppy Disk

Hard Disk:

- The most common physical device for storing files on the hard disk.
- The hard disk typically contains several rotating disk plates, which are permanently encased in a hard disk.
- The surfaces of the plates are covered by metal oxide, electromagnetic recording heads.
- It performs read/write operation.
- There is one head for each surface, and all the heads move together.
- The disk rotates at around 7200 rpm.
- Modern disks typically hold 260 GB to 1000 GB (TB) of data.
- The surface of a plate is organized has several concentric tracks. Each track is divided into sectors. A set of matched tracks are called cylinders.

Floppy Disk:

- Floppy diskette contains a single flat piece of circular plate (the disk) coated with metal oxide and enclosed in a plastic cover.
- Floppy disks are small and portable.
- The three common sizes are 3.5", 5.25" and 8" diameter.
- Most used floppy disks are 3.5" in size with a storage capacity of 1.44 MB of data.

- Disk drives for floppy disks are called floppy drives.
- Floppy disks are slower to access than hard disks and have less storage capacity.
- It is less expensive.

Optical Disk

- Optical disk is a random access, removable disk on which data is written and read through a laser beam.
- Optical disk consists of a rotating disk, which is coated with highly reflective material.
- Data recording on the disk is done by focusing a laser beam on the surface of the spinning disk, which stores data as microscopic light and dark spots on the disk surface.
- The dark spots are called **pits**. The lighter, non-spitted surface areas of the disk are called **lands**.
- The process of recording data onto an optical disk is called burning.
- There are different types of optical laser disks.: CD ROM, DVD ROM and BD ROM

CD ROM

- CD-ROM stands for Compact Disk Read Only Memory.
- It is read only optical storage medium capable of holding up to 682 MB of data.
- Accessing data from CD ROM is quite a bit faster than a floppy disk but slower than a hard disk.
- To read a CD-ROM a device called CD-ROM drive is needed.
- CD technology uses a near-infrared laser.
- There are two types of CD-ROMs. CD-R: It is also called a Recordable CD, CD-RW: It is also called a Re-Writable CD

DVD

- DVD stands for “Digital Versatile Disk”.
- It is an optical disk technology with a 4.7 GB storage capacity.
- DVD can be single or double-sided and can have two layers on each side.

- A double-sided, two-layer DVD will hold up to 17 GB of Video, Audio or other information.
- DVD technology uses a red laser.
- There are two types of DVDs. DVD-R: It is also called DVD Recordable and DVD-RW: It is also called DVD Re-Writable.

Blu-Ray Disk:

- Blu-ray Disk, referred to as BD.
- It is a high-capacity storage technology with 25 GB to 50 GB capacity to store HD movies and other information.
- The name Blu-ray is derived from the blue-violet colour laser, used to read data stored on disk.

Portable Storage Device:

- A Portable Storage Device (PSD) is a small hard drive designed to hold any kind of digital data.
- This is slightly different from a portable media player which stores and plays music and movies.
- Some are fixed-size hard drives of 256 GB, 320 GB, 500 GB and 1 TB.
- It may be a useful alternative to backing up or purging memory cards if a computer is unavailable for downloading.

Difference between Primary and Secondary Memory:

Primary Memory	Secondary Memory
Semiconductor memory.	Magnetic or Optical memory.
Volatile (Temporary)	Non-Volatile (Permanent)
Expensive	Less Expensive
Faster	Slower
Also called as Main Memory	Also called as Auxiliary Memory
Example: RAM, ROM	Example: HDD, Pen drive etc.

Cache Memory

- The cache memory (pronounced as cash) is placed in between the CPU and Main memory.
- It is much faster than the main memory.
- Its access time is much less compared to that of the main memory.
- The cache memory is an intermediate memory and not accessible to users.
- It stores instructions and data, which are to be immediately executed.
- It is used to reduce the average access time reading data, which is normally stored in the main memory.
- The cache memory increases the operating speed of the system. But it is much costlier than the main memory.
- There are two levels of cache memory L1 and L2.
- L1 cache memory will be present inside the CPU, whereas L2 cache will be present on the motherboard.

References

- Ackermann, E., & Harman, K. (2000). *Searching and researching on the internet and world wide web*. Oregon: Franklin, Beedle and Associates, Incorporated.
- Aina, L. O. (2004). *Library and information science text for Africa*. Ibadan: Third World Information Services Ltd.
- Zacharia, A. (1996). *Communication media and electronic revolution*. New Delhi: Kaniska Publishers.
- Divesh, C. (2018). *Input output storage devices in computers*. CCS Haryana, Hisar-125004, India.
- Doyle, L. F. (1991). *A guide for the selection and maintenance of computer peripherals*. Virtual Press. <http://liblink.bsu.edu/uhtbin/catkey/834517>.
- Ghazali, M. S. M., Baharom, R. B., Muhammad, K. S. B., & Lu, D. D. (2022). Computer simulation model of multi-input multi-output converter using single-phase matrix converter. *International Journal of Power Electronics and Drive Systems (IJPEDS)*, 13(2), 1047–1055. <https://doi.org/10.11591/ijpeds.v13.i2.pp1047-1055>.
- Leon, A., & Leon, M. (1999). *Fundamentals of information technology*. <http://inputandoutputdevicesofcomputer.blogspot.com/2012/11/inputand-output-devices-of-computer.html>.