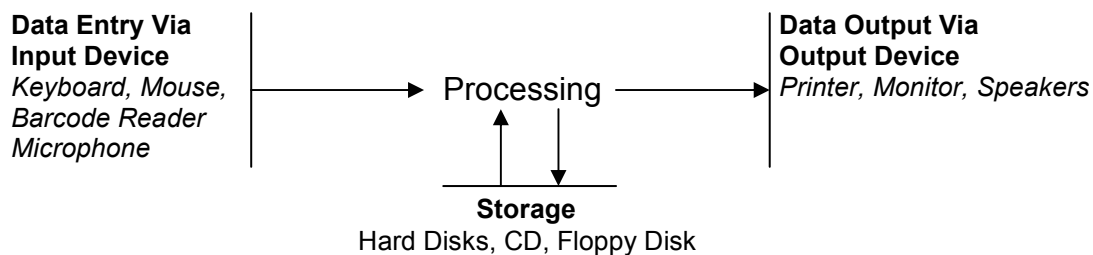


## Lesson

## 5

## Input/Output Devices & Storage Media

Input Devices as well as output devices are a necessity in order to ensure that data is entered into a computer to be processed and the results output. Such data and information need to be stored to eliminate re-entry and/or reprocessing.

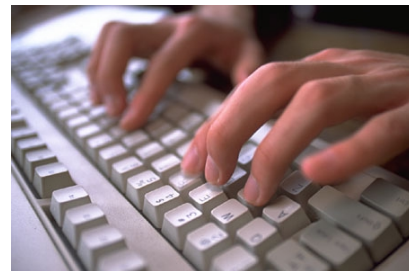


### Input Devices

An input device is a peripheral which accepts data and sends it to the CPU. Data presented to an input device has to be in the right form for the device, e.g. a bar-code reader will only read bar-codes. The input device converts the data into the computer's own internal code before sending it to the CPU.

#### Keyboards

The most common method of data input device is the QWERTY keyboard (so named because of the order of the first few characters on the top row of letters reading from left to right. This is now the standard layout for keyboards in most countries of the world. The computer continuously scans the keyboard and when a key is pressed, a signal is sent to the CPU using the code for the particular character represented by the key.



#### How Keyboards are used

- **On-line data entry.**  
Data is input straight into the computer for processing.
- **Off-line data entry.**  
This is usually achieved by methods known as key-to-disk or key-to-tape. As data is typed using a keyboard, it is recorded on disk or tape. The data is later transferred from the disk or tape to a computer for processing.

#### Mouse

A mouse is used to input data in two different ways. Firstly, as the mouse is moved, a ball underneath it revolves and this movement is detected by sensors which relay the data to the CPU. Secondly, buttons on the mouse act in a similar way to keys on a keyboard. When they are pressed, the code for the relevant control character is sent to the CPU.



**Tracker Ball**

A tracker ball is rotated by hand and as in the case of the mouse, sensors detect the movement of the ball and relay the data to the CPU. The advantage of a tracker ball over a mouse is that it remains stationary and therefore does not require as much space as a mouse.

**Joystick**

A joystick consists of a small lever which is moved by the user to control movement on a screen. Sensors detect the movement of the lever and relay the data to the CPU.

**Bar-Code**

A bar-code is a set of parallel printed lines of differing thickness (usually alternately black and white) which represent a number - see the following picture:



Bar-codes are used on shop goods to identify the product and to give a number code for the following:

- Country of origin.
- Manufacturer.
- An item number for the product.

Note. Prices change frequently and so they are not stored in bar-codes. The price of an item is usually stored in the item's record in a stock file.

**Methods of reading bar-codes:****A hand-held light pen or 'wand'**

When the wand is passed over the bar-code it directs a narrow beam of light onto it, and then measures the amount of reflected light so enabling the computer to distinguish between the black and the white lines.

**A stationary scanner**

When the item is passed over the scanner, a laser beam scans the bar-code and measures the reflected light in much the same way as the light pen does.

**Examples of the uses of bar-codes:**

- On labels on shelves. These are used during stock-taking.
- On the labels of goods. These are used at EPOS/EFTPOS terminals to identify goods.
- In libraries to identify books.

**Magnetic Stripes**

A magnetic stripe is a short length of magnetic tape which may be stuck on the surface of a tag, card or document. On plastic cards such as credit cards, the stripe is usually sealed in. Stripes store data in the form of magnetic spots which represent the 1's and 0's of the ASCII code.

Magnetic Stripes on the back of Bank credit card contains customer account details.



### **Examples of the use of magnetic stripes:**

**Bank cards** The stripe holds data to identify the owner and enables the cards to be used in the following ways:

- at EFTPOS terminals to transfer funds between the customer's and the store's accounts.
- at cash dispensers - in conjunction with a 'personal identification number' (PIN) to withdraw cash or make enquiries.

**Tags** The magnetic stripe is stuck on a tag which is attached to an item and is used to identify that item.

**Phone cards** Some public telephones do not accept coins. Instead a card is used which has a magnetic stripe. The stripe has the value of the card recorded on it. As the card is used, the value is reduced and the new value is recorded on the stripe.

### **Laser cards**

An improvement on magnetic stripes. Data is stored on cards in the form of small holes in a polished surface. The cards are read using reflected light produced by lasers. An advantage of laser cards over a magnetic stripe is that one laser card can store over 2 million characters as opposed to 72 characters on a magnetic stripe.

### **Smart Cards**

These have a memory store in the form of a very thin integrated circuit sealed into them. These can be used to store data about a customer which can be updated as transactions are made using the card.

### **Document Readers**

A document reader is a device which can read data straight from forms. Types of data read by document readers:

#### **Marks**

Short lines made by hand. They are usually in pencil on cards or documents.

#### **Handwritten characters**

When documents are to be filled in by hand, they are pre-printed with spaces provided. The characters have to be written carefully in the right places.

#### **Printed lines**

The most common of these is the bar-code.

#### **Printed characters**

For example, magnetic ink characters on bank cheques.

### **Methods of Reading Marks**

#### **Mark Sensing**

Small electrical 'brushes' touch the surface of the document or card. When they contact a pencil mark, a circuit is completed. The marks must be made by a pencil which contains graphite (HB) as this conducts electricity, e.g. objective test papers.

#### **Optical Mark Reading (OMR)**

A beam of light is directed onto the surface of a card or document. The beam is reflected from the surface to a light sensor. When a mark passes under the beam, less light is reflected back and so the presence of a mark is registered, e.g. National lottery forms.

### **Character Recognition**

The document reader recognises characters which have been printed by machine or by hand. The shape of each character is analysed by the document reader and compared with a set of known shapes.

### **Methods of inputting characters:**

#### **Optical character recognition (OCR)**

With OMR the character shapes are recognised by sensing light reflected from the paper and the ink. The reader has to have a memory and a processing capability in order to identify the characters.

#### **Magnetic ink character recognition (MICR)**

Characters are printed using an ink which contains iron oxide. As the document passes into the reader, the ink is magnetized, so that the character shapes can be recognised by their magnetic signature.

### **Tags**

A tag is a small ticket, usually of cardboard, which contains coded data and which is attached to shop goods to identify them.

Methods of encoding data on tags:

- Small punched holes (Kimball tags).
- Magnetic stripes.
- Bar-codes.
- Characters in an OCR or MICR font.

### **Light Pens**

A light pen is a hand held, pen shaped device which can detect the presence of light. Electrical signals are sent along the cable corresponding to different intensities of light.

Uses of light pens:

- To read bar-codes (as explained above)
- To indicate a point on a monitor screen  
A monitor screen is 'refreshed' about every 1/50th. of a second by a point of light travelling across it. When this point of light is detected by the light pen, the computer can work out, by precise timing, the position of the pen on the screen.

### **Graphics Tablet**

A graphics tablet (also known as a digitising pad or digitiser) is a board which can detect the position of a pen-like stylus on its surface. A design is put on the board and its shape is traced out with the stylus. The device digitises the analogue signal from the stylus and sends the data in digital form to the CPU for processing.

### **Voice Recognition**

A microphone is used to detect speech sounds and relays these in analogue form to an interface. At the interface the signal is converted into digital form and sent to the CPU for processing. Following programmed instructions, the computer analyses the sound patterns received from the microphone and compares these with patterns stored in its memory. In this way, the sound patterns of words can be identified.

### **Touch Sensitive Screen**

This can be used as an alternative to a light pen or keyboard, especially by people who are not familiar with computers. The monitor screen is overlaid with another, transparent screen which is sensitive to touch. With the use of special software, the computer is able to calculate the precise point at which the screen is touched.

Example of use of a touch-screen:

A program can be written which prints labelled squares on the screen. When a point (which coincides with one of the squares) on the screen is touched, the program commands the computer to react in an appropriate way. Such a system can be used by hospital patients to select their meals.

### **Concept Keyboard**

This is similar to a touch-sensitive screen except that the touch-sensitive surface is laid over a board (similar to a graphics tablet in appearance). As in the case of the touch-sensitive screen, the computer is able to detect the precise point at which the surface of the concept keyboard is touched. Concept keyboards are particularly valuable for use with young children who have not learned to read or with people with reading difficulties. For example, a menu which uses small pictures instead of words can be drawn onto a sheet of paper (overlay) and the paper laid over the touch-sensitive surface. When one of the drawings is touched on the paper overlay the computer (with the aid of a program) is able to detect, from its position on the surface, which picture it is.

### **Scanner**

A scanner can be used to convert a picture into digital form so that it can be processed by a computer and printed out. For example, a photograph could be scanned and incorporated into a wordprocessor or desktop publisher document. Like the light pen and the bar-code reader, a scanner measures the levels of reflected light and codes these into a digital signal which is processed by a CPU. There are various designs of scanner, e.g. some are hand-held and others are flat-bed types. Some scanners produce only black and white pictures (with colours being represented by shades of grey) while others faithfully reproduce the original colours.



### **Video Digitiser**

This device allows a video frame to be digitised and relayed to a computer for processing. Once the image of the video frame is held in a computer, it can be used in the same way as a scanned picture and incorporated into computer documents.

### **Digital Camera**

A digital camera (as its name suggests) stores its data in digital form on its own internal memory and so there is no need to use a digitiser. The digital signal from the camera is sent through leads directly to the computer's serial port.



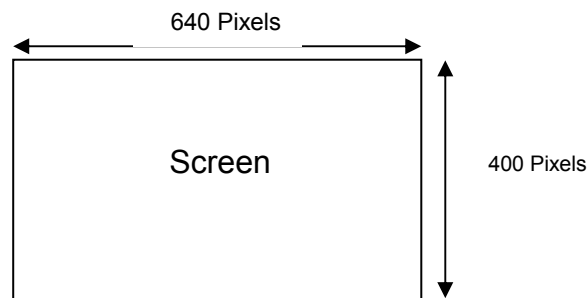
## Output Devices

These usually receive data from the CPU and change it into a form which can be understood by humans. However, in some cases (for example when the computer is used to control another device), the output may be in a form which is suitable for passing instructions to another device controlled by the computer.

### Monitor

Note: a 'monitor' is often mistakenly referred to as a VDU which is a type of computer terminal. A monitor is an output device which outputs data in human readable form onto a video screen. Monitors vary greatly in size and in resolution (clarity of graphics). The resolution is determined by the number of pixels on the screen, that is the number of spots which can be lit-up by an electron stream fired from within the monitor.

The higher the number of pixels, the higher the resolution. The pixels are displayed on the screen in the form of an array (matrix). The greater the number of pixels in the array the higher the resolution of the monitor. There are 3 common qualities of monitor:



VGA (Video Graphics Array):	640 x 400 pixels.
SVGA (Super Video Graphics Array):	800 x 600 pixels.
EVGA or X VGA (Extended Video Graphics Array):	1024 x 768 pixels.

### Printers

Printers are used to print the output data on paper. Such output is referred to as printout or hard copy. There are many different types of printer but only the most common types are listed here:

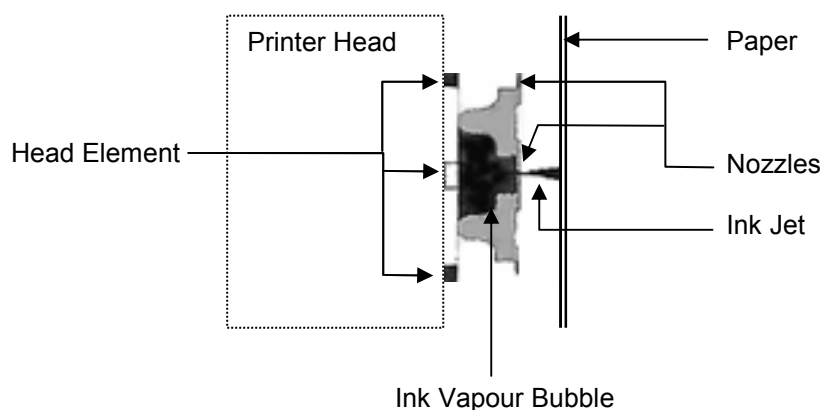


#### Dot Matrix Printers

These use rows (a matrix) of needles which are made to impact with an ink-ribbon to make the pattern of the required character on the paper. Although they are relatively cheap to buy, dot-matrix printers are very slow, very noisy and do not give a high quality of print.

### **Ink-Jet Printers**

These squirt quick-drying ink onto paper to form the shape of the character being printed. In comparison to dot-matrix printers, ink-jet printers are quick, quiet and give a good quality of print; however they are more expensive.



### **Bubble-Jet Printers**

Similar technology as Ink-Jet but manufactured by Canon.

### **Laser Printers**

These work in a similar way to photocopiers. A laser beam is used to create an electric charge which attracts special black dust to it. The dust is then transferred to the paper to produce the printed output. Laser printers are faster and quieter than ink-jet printers and produce a very high quality print. They are also relatively expensive.

### **Graph Plotters**

Graph plotters are devices which, in response to output signals from the computer, cause a pen to move across a sheet of paper to produce drawings such as graphs. There are two basic types of graph plotter:

- **Flat-Bed Plotter**  
A sheet of paper is laid flat (on a bed) and a pen moves across it in two directions to produce the drawings.
- **Drum Plotter**  
The sheet of paper is attached to a drum and as the drum revolves, a pen moves from side to side to produce the drawings.



### **Computer Output On Microfilm (COM)**

Special computers can produce their output directly onto microfilm. In this way, vast amounts of data in human readable form can be stored in a very small space without the need of large quantities of paper. This form of output has applications in libraries, book shops and in situations where large amounts of text and pictures need to be sent through the post. The microfilm is read by using a special device which magnifies the text and pictures so that they can be seen by eye.

### **Sound**

Computers can be used to output sound in the form of speech and music. This has obvious applications in entertainment and musical composition, and the ability of computers to produce speech has important implications for their use by visually impaired people.

## Backing Store Devices and Media

The main memory store in a CPU is normally volatile, i.e. all data in memory is lost when the power is turned off. It is therefore necessary to put important data into a permanent store so that it can be retrieved at a later date. There are various types of backing store devices and media, the most common of which are described below:

### Floppy Disks

These are small disks which are coated with a substance which can be magnetised. The disk is the storage medium and data is stored on it in the form of small spots of magnetism. In order to store (save or write) the data on the disk or to re-input (load or read) it into the computer a backing store device known as a disk drive is used.



### Hard Disks

Hard disks are similar to floppy disks in the way in which they store data. There are usually several disks, stacked on a spindle and these are stored inside the HARD DRIVE. Hard drives can either be internal (placed inside the computer casing) or external (plugged into an interface or port). As in the case of the floppy disk, the hard disk is the storage medium and the hard drive is the backing store device.



### Magnetic Tape



Magnetic tape also has a coating of a substance which can be magnetised and in a similar way to a floppy disk, data is stored on the tape in the form of spots of magnetism. Again, the tape is the storage medium and the tape drive is the backing store device.

### CD-Rom

A CD ROM consists of a compact disc (CD) on which vast amounts of data are stored in the form of microscopic holes in the shiny surface of the disc. A very narrow beam of light, provided by a laser, is shone onto the surface of the disc and the amount of reflected light is measured. Where there is a hole in the shiny surface the level of reflected light is low, where the shiny surface is intact the level of reflected light is high. ROM stands for READ ONLY MEMORY and because (currently) most computers do not have facilities for writing (saving) data onto compact discs they can only be read.

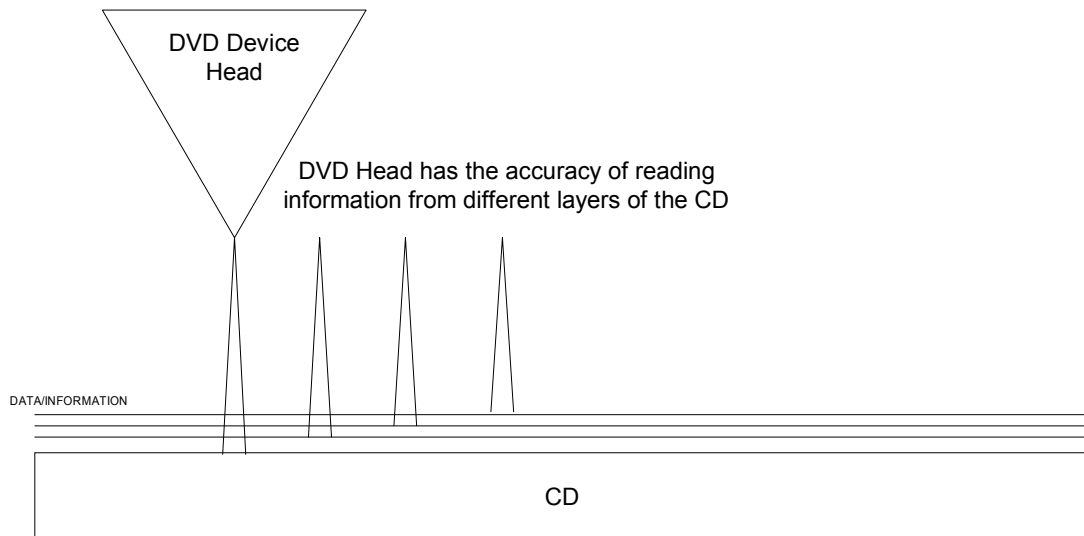
Data is usually stored on CDs using special equipment in factories or in recording studios. However today CR ROM writers are becoming popular as their prices fall. CD writers write to special CD ROMs which are coated in a light sensitive pigment. CD R can be written to once only but CD RW can be written to over and over again as with magnetic media.

A CD ROM is a storage medium and data can be read from it using a CD ROM DRIVE.



**DVD's**

DVD (Digital Versatile Disc) technology is fairly recent it allows storage of data in the form of several layers on a CD, hence the storage of full length movies is possible!



**Exercise 1 - Computer Products Research**

Using the Internet; establish the range of products currently available under input/output and other media?

E.g.

- VDU (Monitors)
- Keyboards
- Computers
- Scanners
- Printers

Emphasis must be placed on price, brand, and age of technology, product specification and key benefits.

Your findings must be represented in the form of a table(s); e.g.

**INPUT**

Product	Brand	Price	Age of Technology	Product Spec	Benefits etc.
VDU	LG	\$200	1 year old		

**OUTPUT**

Product	Brand	Price	Age of Technology	Product Spec	Benefits etc.
Printer	Epson	\$150	Current		

## Exercise 2 - Computer Products Research

You have been employed as a computer consultant, your task is to decide

Highline Community College is about to expand its computer equipment - due to student demand and the addition of several courses to its existing curriculum. The following areas are of particular interest:-

Arts and Graphics Design  
Business & Accountancy

The new equipment must include up to date hardware and meet current and future needs. You are required to justify the hardware being proposed, and present your findings to the Head of Department.

**Note:** Different equipment will be viable for different departments, justify why certain equipment has been chosen.

*1. Present your findings to the Head of Computing*

Your presentation should focus on justifications of why specific hardware components have been chosen (specify how different systems would meet different user needs and avoid technical issues).

*2. Present your findings in report format.*

The report must include the technical issues of the hardware being proposed (purpose and importance of specific hardware components). Technical issues could refer to speed, functionality, price etc.

Your report must not exceed **1000 words**.