IGCSE Information Communication Technology (ICT) Syllabus code 0417

Section 2

Input and output devices

Monitor/Screen

Computer case

Drive

Mouse

Keyboard

Scanner   Printer
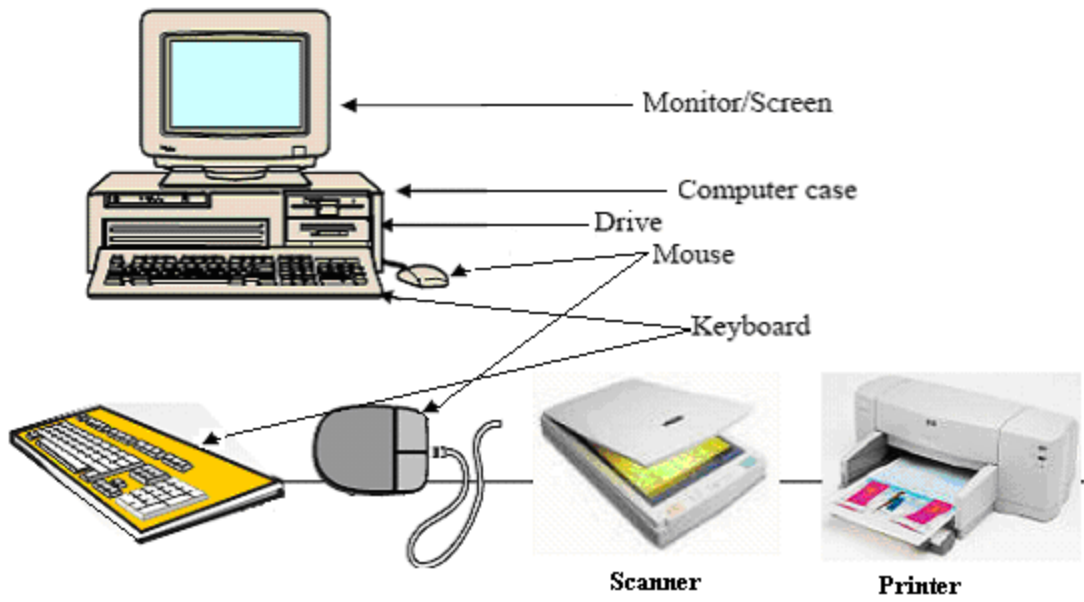
Section 2

a. Identify the following input devices:

keyboards, numeric keypads, pointing devices (including mouse, touch pad and tracker ball), remote controls, joysticks, touch screens, magnetic stripe readers, chip readers, PIN pads, scanners, digital cameras, microphones, sensors, graphics tablet, MICR, OMR, OCR, barcode readers, video cameras, web cams, light pens

b. Identify suitable uses of the input devices stating the advantages and disadvantages of each:

Sensors (general) in control and measuring applications, see section 7.1	
Temperature sensor	Automatic washing machines, automatic cookers, central heating controllers, computer-controlled greenhouses, scientific experiments and environmental monitoring
Pressure sensor	Burglar alarms, automatic washing machines, robotics, production line control, scientific experiments and environmental monitoring
Light sensor	Computer controlled greenhouses, burglar alarm systems, robotics, production line control, scientific experiments and environmental monitoring
Graphics tablet	Inputting freehand drawings or retouch photographs
Optical Mark Reader	Inputting pencil marks on a form such as a school register, candidate exam answers, any application involving input of a choice of options
Optical Character Reader	Inputting text to a computer ready for processing by another software package such as word processors, spreadsheets, databases etc.
Bar code Reader	Inputting code numbers from products at a POS terminal, library books and membership numbers
Video camera	Inputting moving pictures, often pre-recorded, into a computer
Web cam	Inputting moving pictures from a fixed position into a computer
Light pen	Where desktop space is limited, it is used instead of a mouse or for drawing applications where a graphics tablet might be too big

Device	Use
Keyboard	Entering text into a word processing document. Applications where text has to be created rather than copied
Numeric keypad	Applications where only numeric data is to be entered. Inserting personal identification number (PIN) for Chip and PIN credit/debit cards, or when using an ATM machine to withdraw money or check a bank balance
Pointing devices – all	All applications which require selection from a graphical user interface. For example: the selection of data from a set list or menu
Mouse	In most PCs
Touch pad	On laptop computers
Trackerball	For use by people with limited motor skills e.g. young children or people with disabilities
Remote control	Using remote control devices to operate TVs, video players/recorders, DVD players/recorders, satellite receivers, HiFi music systems, data or multimedia projectors
Joystick	Used by a pilot to fly an aeroplane or flight simulator. Used in car driving simulators and for playing games
Touch screen	Selecting from a limited list of options e.g. certain POS uses such as cafes, tourist information kiosks, public transport enquiries
Magnetic stripe readers	At POS terminals, ATMs and in security applications
Chip readers and PIN pads	Payment cards, ID cards, door control systems, public transport tickets
Scanners	Entering hard copy images into a computer
Digital cameras	Taking photographs for input to computers, for input to photo printers
Microphones	Recording of voices for presentation software

c. *Identify the following output devices: monitors (CRT, TFT), projectors, printers (laser, ink jet and dot matrix), plotters, speakers, control devices – motors, buzzers, lights, heaters*

d. *Identify suitable uses of the output devices stating the advantages and*

Device	Use
CRT monitor	Applications where space is not a problem. Applications where more than one user may need to view screen simultaneously such as in design use, e.g. when several designers may need to offer suggestions on a prototype
TFT monitor	Applications where space is limited such as small offices. Applications where only one person needs to view the screen such as individual workstations
Multimedia Projector	Applications such as training presentations, advertising presentations and home cinema – it displays data from computers, pictures from televisions and video/DVD recorders
Laser printer	Applications which require low noise and low chemical emissions, e.g. most networked systems. Applications which require rapid, high quality and high volumes of output, e.g. most offices and schools
Inkjet printer	Applications which require portability and low volume output, where changing cartridges is not an issue e.g. small offices and stand alone systems. Applications which require very high quality output and where speed is not an issue, e.g. digital camera applications
Dot matrix printer	Applications where noise is not an issue and copies have to be made, e.g. industrial environments (multipart forms, continuous stationery, labels etc.), car sales and repair companies, manufacturing sites
Graph plotter	CAD applications, particularly where large printouts are required such as A0
Speakers	Any application which requires sound to be output such as multimedia presentations and websites including encyclopaedias. Applications that require musical output such as playing of music CDs and DVD films

Control devices in Control applications, see section 7.1	
Motors	Automatic washing machines, automatic cookers, central heating controllers, computer-controlled greenhouses, microwave ovens, robotics, production line control
Buzzers	Automatic cookers, microwave ovens
Heaters	Automatic washing machines, automatic cookers, central heating controllers, computer-controlled greenhouses
Lights/lamps	Computer-controlled greenhouses

Advantages and Disadvantages of a range of Output devices

Monitors:

The computer **monitor** (*also known as a **VDU** or **V**isual **D**isplay **U**nit*) is the most common computer output device. For desktop computers, cathode ray monitors (**CRT**) are gradually being replaced by flat-screen monitors such as the Liquid Crystal Displays (**LCD**) and Thin Film Transistor (**TFT**) displays used with laptop computers because they use less power and take up less space.

Suitable uses - displaying text, images and numbers in full colour.

Advantages - **relatively cheap** and **reliable**, can **display text** and **graphics** in a wide range of **colours**. They are also **quiet** and **do not waste paper**.

Disadvantages - **no permanent copy** to keep and **unsuitable for users with visual problems**.

Printers:

Printers produce a printed 'hard copy' on paper. Different printers are suited to different purposes and have a range of purchase and running costs.

Printers can be divided up into **three** main types.

1 - Dot matrix printers,

How it works

The print head travels from side to side across the paper and is made up of numerous pins which are pushed out to form the shape of each character

The pins hit an ink ribbon against the paper so the characters are printed out.

The paper is usually continuous with holes down each side and perforations so the pages can be easily separated by tearing.

Because the pins make an impact against the paper the characters can be printed through several layers of self-carbonating paper to produce duplicate copies.
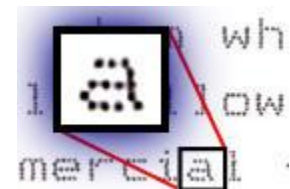
Suitable uses:
- Limited to situations where duplicate copies are needed and the quality is not too important.
- Typical uses might be in **warehouses** where duplicate copies of orders need to produced quickly and cheaply.

Disadvantages:
- The printing **quality is low** - these printers produce low to medium quality black and white printing and can only print low resolution graphics.
- Because of the impact of the pins against the paper, these printers can be **quite noisy**.

Advantages:
- The **purchase cost is low** and the **running costs are very low**.
- They can print **fairly quickly**, particularly if you remember that multiple copies are being printed in one print run.
- They are **robust** and can operate in **harsh environments**.
- If several sheets of self-carbonating paper are placed into the printer then the impact will produce **duplicate copies**.

2 - Ink-jet printers:

How it works:
- The print head contains tiny nozzles through which different coloured inks can be sprayed onto the paper to form the characters or the graphic images.
- The ink is forced out by heat or by tiny piezoelectric crystals which change shape when an electric current is applied across them.

Suitable uses:
- A popular choice for **home use** where small amounts of printing are done and photographic quality colour printing is needed.

Disadvantages:
- The ink cartridges can be expensive so **running costs can be high**.
- The **printing speed is slow** compared to a laser printer.

Advantages:
- These printers are **relatively inexpensive** and produce **high quality** black and white or photographic quality borderless colour printing.

3 - Laser printers:

How it works:
- These print individual pages and work in a similar way to photocopiers.
- A drum is charged to match the image and powdered ink (toner) sticks to the surface. The toner is then transferred to the paper and fixed by heat and pressure.
- A school or business printer would have a typical speed of 10 to 20 pages per minute (ppm).

Suitable uses: • Common wherever fast, high quality printing is required.

Disadvantages: • Non-colour laser printers are **more expensive than ink-jet printers** (*but the difference is narrowing*).
• Colour laser printers are **considerably more expensive**. (*but their speed and high quality output means they are becoming more popular*).

Advantages: • They are **quiet** and **fast** and produce **high quality printouts**.
• **Running cost are low** because although toner cartridges are expensive to replace, they last a long time.

Plotters:

How it works: • A **drum plotter** prints by moving a pen sideways over the surface of a sheet of paper.
• One high precision motor moves the pen from side to side.
• Another high precision motor moves the paper backwards and forwards.
• An electromagnet lifts and drops different coloured ink pens onto the paper to draw lines.

• A **flat-bed plotter** uses two high precision motors, one to move the pen in the X direction and one to move it in the Y direction. The paper does not move.

Suitable uses: • Plotters are restricted to line drawing and can only create a solid region of colour by drawing a number of close, regular lines.
• Plotters are often used in science and engineering applications for drawing building plans, printed circuit boards and machine parts.

Advantages: • They are **accurate** and can produce **far larger printouts** than standard printers.

Disadvantages: • **Slow and relatively expensive** compared to printers.
• They cannot print raster (*photographic*) images.
• They can only fill solid blocks of colour using closely hatched lines.

Braille printer - by converting text into the Braille code, this printer produces patterns of raised dots on paper for use by the blind.

Electrical Transducers:

An electrical transducer converts an electrical current into an output such as light, sound or movement.

Speakers:

These transducers convert an alternating electrical current into sound.

- **Suitable uses -** They can output music as well as the spoken word. Useful for blind users where text or figures can be spoken by the computer. A speaker and computer-synthesised voice can be used by automated systems to read information such as telephone numbers or traffic updates.
- **Advantages** - Cheap and widely available. Capable of producing very high quality sound.
- **Disadvantages** - they are an analogue device so the digital sound signal has to be converted, usually by a sound card.

Lights:

Light Bulbs: These use too much current to be powered directly by a computer but they can easily be switched on using a relay which is an an electronic switch. In a relay a small current controls an electromagnetic switch which can turn on or off the much larger current which powers the light bulb.

- **Suitable uses -** Light bulbs are used with relays and control systems in signalling, automatic lighting and burglar alarms.
- **Advantages** - **Cheap** and widely available.
- **Disadvantages** - They cannot be powered directly from a computer so need a relay to control them.

Light-emitting diodes (LED's): These convert a small electrical current directly into light and can be powered directly by a computer. Today's LEDs can be found in just about every colour of the spectrum including invisible infra-red.

- **Suitable uses -** LED's are commonly used to indicate various events such as 'power on' or 'hard disk in operation' and to monitor other control applications. Infra-red LED's are used to transmit the data from a remote control to the receiver.
- **Advantages** - **Cheap**, widely available and very reliable. LED's use a tiny current so can be powered directly from a computer.
- **Disadvantages** - None.

Motors:

Motors are not usually powered directly from a computer as they use too much current. They are usually controlled through a relay which is an electronic switch. In a relay a small current controls an electromagnetic switch which can turn on or off the much larger current which powers the motor.

- **Suitable uses -** In control technology, a computer can be programmed to turn motors on and off using relay switches. Examples include electronic doors and windows, cooling fans etc. Motors are used in the automobile industry to move **robot arms** that spray body shells or assemble and in electronics manufacturing to assemble delicate electronic components on a printed-circuit board.
- **Advantages** - **Cheap**, widely available and very accurate.
- **Disadvantages** - They cannot be powered directly from a computer so need a relay to control them.

Buzzers:

These cheap transducers change a current directly into a simple sound. They use a low current so can be powered directly from a computer.

> **Suitable uses -** Often used as alarms or warnings in computer control systems.
> **Advantages** - **Cheap** and widely available. They use a tiny current so can be powered directly from a computer.
> **Disadvantages** - Limited volume and they can only produce a limited range of sounds.

Advantages and Disadvantages of a range of Input devices

Mouse

The **mouse** is used to control the movement of a pointer on the screen when it is moved horizontally over a flat surface.

A ball under the mouse rotates when it is moved and turns two rods, one for left/right and one for up/down.

Buttons on the mouse let you select options from menus and drag objects around the screen etc. Some models are now wireless.
Uses:

- Movement - controlling a screen pointer
- Buttons - selecting items / menus etc.

Advantages:

- Ideal for use with desktop computers.
- Usually supplied with a computer so no additional cost.
- All computer users tend to be familiar with using them.

Disadvantages:

- They need a flat space close to the computer.
- The mouse cannot easily be used with laptop, notebook or palmtop computers.

*(These need a **tracker ball** or a touch sensitive pad called a **touch pad**).*

Standard Keyboard

The standard QWERTY keyboard is the commonest way to enter **text** and **numerical** data into a computer.

Each individual key is a switch, which when pressed, sends a digital code to the computer.

For example, pressing the '**A**' key produces the binary code **01100001** representing the lower case letter '**a**'. Holding down the shift key at the same time produces the binary code **01000001** representing the upper case letter '**A**'.

Advantages:

- Reliable for data input of text and numbers.
- Usually supplied with a computer so no additional cost.
- Specialised keyboards are available.

Disadvantages:

- Users may be slow for not very accurate typists.
- Slow for accessing menus etc. and difficult to use if you want to move objects around the screen.
- Difficult for people unable to use keyboards through paralysis or muscular disorder.

Digital camera

These are used to take photographs like a normal camera but produce digital images instead of using film.

The light passing through the lens is digitised by special **light sensitive sensors**. The image is stored on memory chips in the camera and can then be transferred to a computer.

The resolution of such cameras is increasing rapidly and professional models have become standard in photo-journalism. Images are usually compressed as jpeg's to save memory.

Advanced models have removable **memory cards** to increase the camera's storage capacity. Images can be transferred to a computer by cables or memory card readers.

Advantages:

- No film is needed and there are no film developing costs
- Unwanted images can be deleted straight away
- Images are already digital and can easily be transferred to a computer and edited or

transferred over the Internet
- Special image editing software can allow a huge range of adjustments and special effects to be tried

Disadvantages:

- Images often have to be compressed to avoid using up too much expensive memory.

Scanner

These are used to digitise images of pages or objects.

A light moves slowly over the surface of the picture or object to be scanned. The colours of the reflected light are detected and digitised to build up a digital image. The digital data can then be saved by a computer as an image file.

They can be used with <u>OCR</u> software to convert **images of text** into actual **text data** which can be edited by a word processor.

Advantages:

- Flat-bed scanners are very accurate and can produce images with a far higher resolution than a digital camera

Disadvantages:

- Can produce very large image files which need a lot of computer memory to view and edit

Magnetic Stripe Reader

Magnetic stripes are thin strips of magnetic tape which are usually found on the back of plastic credit and debit cards.

When the card is inserted into a reader (*in an Automatic Teller Machine or ATM for example*) the tapes slides past a playback head similar to that used in a tape recorder. This reads the data from the stripe and passes it to a computer.

Advantages:

- Simple to use and cheap to produce. The data can be altered if necessary.

Disadvantages:

- Very limited storage capacity. Data easily destroyed by strong magnetic fields.
- Not very secure as thieves can obtain the readers and alter the data.

Joystick

Joysticks are often used for playing computer games such as flight simulators. They can also be used to control the movement of a wheelchair or other machinery.

They input directional data like a mouse but work by switches being closed as the joystick is moved left or right and up or down.

Mini finger-controlled joysticks can be used to control a laptop cursor.

Advantages:

- Easy to learn to use. Very simple design so they can be inexpensive.

Disadvantages:

- Control can be a bit crude as the directions in simple joysticks are limited to forward, backwards, left and right. Better models offer diagonal movement or better.

Microphone

This is used for the input of sound which is then digitised by the computer. The digital audio can be saved for playback later on.

The digital audio can also be used with voice-recognition software to control hardware, navigate a menu or input text into a word processor. Voice recognition can also be used in security systems.

Advantages:

- Voice recognition software can be used to convert your voice into text or to control menu options on a phone system.

Disadvantages:

- Stored audio files can take up a lot of memory.
- Voice commands can be difficult to recognise by the software.

Video digitiser

A video digitiser is used to convert sequences of <u>analogue</u> images into a <u>digital</u> format.

The **digitised** images can then be saved as a file and played back on a monitor to produce a moving image.

Software will allow the video to be edited and special effects added, as well as individual still images to be captured and saved. Digital video cameras digitise the image inside the camera and save the video frames in a digital format. This data can then be transferred directly to the computer via a fast transfer cable and interface such as Firewire.

Advantages:

- Digital video is easily edited. Sections can easily be cut and pasted together and digital effects added.
- The output can be rendered into a wide range of formats ranging from DVD quality down to streaming video suitable for the Internet.

Disadvantages:

- Video files take up a great deal of memory.
- Fast video capture cards may be needed to capture high quality video footage.
- A powerful computer and graphics card is often needed to process video footage.

MIDI instruments

MIDI stands for Musical Instrument Digital Interface. These are normal musical instruments which have a MIDI port for input into a MIDI interface in the computer.

The notes are converted into digital data and saved as a file on the computer. This data can be converted back into notes or edited by computer software.

The software often has a wide range of special effects or stored sound data from real instruments.
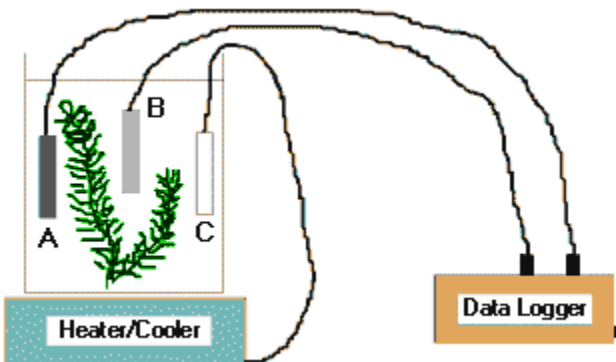
Advantages:

- Data from a musical instrument is easily captured and edited with a computer.
- MIDI files are small.
- MIDI files can be recorded on one type of instrument and played back on another.

Disadvantages:

- Audio cannot be recorded directly as an audio files such as MP3.

- The playback depends on the instrument/computer sound card so may not sound the same as the original.
- Only the note and the timing are stored.

Sensors

These detect changes in the physical or chemical environment and convert them into electrical signals. These signals can then be digitised and used by the computer.

Sensors are often used when **data logging**.

Advantages:

- There are a huge range of possible sensors and they include: heat; light; sound; movement; magnetism; pressure; strain; acidity (pH); oxygen levels; liquid levels; humidity; pulse rates; salinity; water flow; speed and acceleration. Switch sensors can detect angles of tilt or whether something is open or closed.

Disadvantages:

- Most sensors need an interface to convert analogue signals into the digital signals that a computer can understand.

Remote control

These emit a beam of infra-red light which carries digital data signals. They are often used to control TV's and VCR's.

More advanced models can be programmed to transmit a series of commands with one button press.

Advantages:

Each function can have its own button making them very simple to use.

Disadvantages:

Only advanced models can be have the buttons reprogrammed so they cannot be used to control anything other than the device they were designed for.