

# Input and Output Devices

## 2.1 Input devices and their uses

- Hardware which allows data to be input into a computer

### Keyboard

#### Uses:

- Input of data into applications software
- Typing in commands to the computer

#### Advantages

- i. Fast entry of new text into a document
- ii. Easy to use for most people
- iii. Easier to do verification checks as the data is entered

#### Disadvantages

- i. Can be difficult if user has limited arm/wrist use
- ii. Slow method when compared to direct data entry
- iii. Fairly large device that uses up valuable desk space

### Concept Keyboard

- Uses icons or phrases instead of standard letters.
- Allows fast data entry
- Waterproof
- Tamper-resistant, prevents people from keying in information that could potentially corrupt the system

### Numeric Keypads

- A numeric keypad is used to enter numbers only

#### Uses:

- ATMs, where customers have to key in numerical data
- Mobile phones
- POS, in case barcode readers fail to read barcode
- Chip and Pin devices
- Entry of numerical data into a spreadsheet

#### Advantages

- i. Faster than standard keyboards when entering numeric data
- ii. Portable

#### Disadvantages

- i. They have small keys which make input difficult
- ii. Order of numbers on keypad may not be intuitive

### Pointing devices

#### Uses

- Opening, closing and minimising software
- Grouping, moving and deleting files
- Image editing
- Controlling the position of the pointer on the screen to allow a selection from a menu, selecting an icon or scrolling up and down

#### Advantages

- i. Faster way to choose an option than using a keyboard
- ii. Very quick way to navigate through applications and the internet
- iii. Does not need a large desk area

#### Disadvantages

- i. Can be more difficult for people with restricted wrist movement
- ii. Easy to damage
- iii. Difficult to use if no flat surface is available

### Touchpad

#### Advantages

- i. Same as a mouse
- ii. Aids portability as it is integrated into the laptop computer and does not need a flat surface

#### Disadvantages

- i. People with limited hand/ wrist movement may find the device difficult to use
- ii. Can be more difficult to control the pointer when compared to a mouse
- iii. More difficult to do certain operations

### Tracker ball

#### Uses

- Used in applications where the user has a disability
- Used in a control room environment where it is faster than a mouse to navigate through screens
- Used in some luxury automobiles to select functions

#### Advantages

- i. Doesn't need the same fine control as a mouse

- ii. Easier to use if the operator is disabled
- iii. More accurate positioning of the pointer on the screen than the mouse
- iv. They are more robust than a mouse
- v. Needs less desk space than a mouse or keyboard

#### Disadvantages

- i. Not supplied with computers as a standard, therefore more costly
- ii. User may need training as it is not standard equipment

#### Remote controls

##### Uses

- Used to control functions on televisions, satellite systems, DVD players and hi-fi systems
- Used to control multi-media systems
- Used in industrial applications to remotely control processes

#### Advantages

- i. Can be operated from a reasonable distance

#### Disadvantages

- i. Difficult to use if there is limited hand/wrist movement
- ii. Signal can be easily blocked by signals

#### Joysticks

- Used in video/computer games
- Self-service tills
- ATMs
- POS
- Computer based training

- i. Faster entry of options than using a keyboard or mouse
- ii. Very easy method of choosing options
- iii. User-friendly

#### Disadvantages

- i. Limited number of options available
- ii. Can lead to problems if an operator has to use a system frequently

- Used in simulators to mimic actual controls

#### Advantages

- i. Easier than a keyboard to navigate the screen
- ii. Control is more realistic than a mouse

#### Disadvantages

- i. More difficult to control than on-screen pointer devices, such as a mouse

#### Driving wheel

##### Uses

- Used in video/ computer games
- Used in simulators to mimic actual vehicle controls

#### Advantages

- i. Easier than a keyboard or joystick to control steering movements
- ii. The driving experience is nearer to how an actual steering wheel and other controls operate in real life

#### Disadvantages

- i. It can be a rather expensive input device compared to a mouse or joystick
- ii. Movements in the steering can be too sensitive, giving an unrealistic feel
- iii. Unless it is an expensive simulator, feedback to the driving wheel is non-existent

#### Touch Screens

##### Uses

- Public information systems
- Personal digital assistants
- Interactive white boards

#### Advantages

- iii. The screen can get dirty with constant touching reducing responsiveness and clarity of screen in strong light

#### Scanners

##### Uses

- Scan in documents and convert into a format for use in various software packages
- Scan in old /valuable documents/ books thus protecting the originals as well as producing records in case the paper copies are lost/ destroyed

- Scan in photographs
- Scan in barcodes at POS terminals

### Advantages

- Images can be stored for editing at a later date
- Much faster and more accurate than typing in documents again
- It is possible to recover damaged documents and photographs by scanning in and then using appropriate software to produce an acceptable copy

### Disadvantages

- Quality can be limited depending on how good a resolution the scanner is capable of
- They can be fairly slow at scanning, especially if the colour scanning mode is chosen or if the chosen scanning resolution is high

### Digital cameras

#### Advantages

- Easier to produce better-quality photographs than with a traditional camera
- Easier and faster to upload photographs to a computer rather than having to scan several hard copies using traditional methods
- No need to develop film to print out photographs anymore- this saves money and is more environmentally friendly
- Memory cards can store several hundred photographs

#### Disadvantages

- User needs to be computer literate
- There is some artistry lost since clever software corrects error in the photographs
- The resolution still isn't as good as many expensive traditional cameras
- Images often need to be compressed to reduce the amount of memory used

### Video Cameras

- Although many digital cameras are capable of taking moving pictures, specialist video cameras exist
- These cameras are often referred to as DV (digital video) cameras, they store compressed photo frames in the form of Motion jpeg

- In DV cameras it is much easier to manipulate footage using specialist software
- DV gives a very high quality image which aids effective editing
- The main issue is the cost of storage, however, this reduces with time and demand

### Microphones

#### Uses

- To input sounds to be used in various applications
- Input in voice recognition software:
  - Software converting speech to text
  - Recognising commands
- Used as a sensor to pick up sounds
- Used in video conferencing or VOIP applications

#### Advantages

- Faster to read text than to type it into keyboard
- It is possible to manipulate sound in real time
- If used in a voice activation system, it has the advantage of improving safety

#### Disadvantages

- Sound files can use up a lot of computer memory
- Voice recognition software isn't as accurate as typing in manually

### Analogue Sensors

- Inputs data to a computer, the data is a measurement of some physical quantity that is constantly changing
- The information from sensors need to be converted using an ADC (analogue to digital convertor)
- Sensors are used in both monitoring and control applications

#### Advantages

- More accurate readings taken as compared to human operators
- Readings are continuous-no break in monitoring
- Because it is a continuous process any necessary action or warning will be initiated immediately
- Systems can be automatic, removing the need for human intervention

#### Disadvantages

- Faulty can give spurious results

## Graphic tablet

### Uses

- Used to produce drawings, computer graphics
- In countries where the written language uses complex characters, graphic tablets are used as a form of input as it is faster than typing in characters with a standard keyboard
- Used in CAD

### Advantages

- i. Possible to modify designs before they are input
- ii. They offer a very accurate method of drawing
- iii. They can record levels of pressure

### Disadvantages

- i. They are more expensive than other pointing devices
- ii. It takes longer to produce a drawing with this equipment rather than a pen and paper
- iii. Menus are not often user friendly
- iv. Large drawings are expensive to produce
- v. The touch screens are damaged easily

## Webcams

### Uses

- Many people use webcams as a more personal way of having a conversation while chatting online
- They are used to enable video conferencing to take place

### Advantages

- i. They can be left on constantly, only activated as required this means it is possible to have an immediate face to face video chat much like instant messages with images
- ii. They allow people to keep in contact with each other without the need to travel

### Disadvantages

- i. They have limited features and are often of poor quality

## Light Pens

### Uses

- Selecting objects on CRT screens
- Drawing on screens

## Advantages

- i. Greater accuracy than touch screens
- ii. Small (can be used where space is an issue)
- iii. Easy-to-use technology

## Disadvantages

- i. Problems with lag when drawing on the screen
- ii. Only works with CRT monitors
- iii. Not that accurate when drawing
- iv. Rather dated technology

## Magnetic Stripe Readers

### Uses

- On credit/debit cards at ATMs or EFTPOS
- Security devices to allow entry to buildings, hotel rooms etc.

### Advantages

- i. Fast data entry compared with keying in data with keyboard or keypad
- ii. Error free
- iii. Secure
- iv. Prevents access to restricted or secure areas
- v. Not affected by oil, water or moisture
- vi. Physically robust

### Disadvantages

- i. Damaged by exposure to strong magnetic fields and data is lost
- ii. Doesn't work from a distance
- iii. Information cannot be read by human beings

## Contactless Card Readers

- Allows customers to pay for items up to \$25 without entering their PIN

### Procedure

1. Customers look for the contactless symbol at the payment terminal
2. The shop assistant enters the amount for payment
3. The card reader informs the customer to present their contactless card
4. The customer holds their card in front of the card reader
5. The terminal display will indicate that the card has been read

### Advantages

- i. Faster transaction as compared to a magnetic stripe reader
- ii. The system uses encryption to protect data
- iii. Customers do not need to worry about typing errors
- iv. Retailers do not have access to customer's debit or credit card details

#### Disadvantages

- i. They are more expensive than normal debit or credit cards
- ii. Can take twice as much money if used as a chip and PIN card
- iii. Transactions are usually limited to a small minimum value
- iv. Transactions could be carried out without the card holder being aware of this

#### Chip and PIN readers

- They are similar to the contactless card system except: the customer has to key in their PIN to make a transaction and the cards do not use RF technology

#### Uses

- Where payments are made using cards

#### Advantages

- i. More secure system
- ii. More robust system than magnetic stripes

#### Disadvantages

- i. Fraud

#### Radio Frequency Identification (RFID) Readers

- RFID readers use radio waves to read and capture information on a tag. The tag can be read from a distance of several meters.
- The RFID tag is made up of two components:
  - i. A microchip that stores and processes information
  - ii. An antenna that is used to receive and transmit data
- The tag can be passive or battery powered.

#### Uses

- Livestock tracking
- Retail
- Admission passes
- Libraries

#### Advantages

- i. No line of sight is necessary, the tags can be read from a distance
- ii. It is very robust and reliable technology
- iii. Very fast read rate
- iv. Bidirectional data transfer (allows reading and writing to happen at the same time)
- v. Bulk detection (can detect several RFID tags at the same time)

#### Disadvantages

- i. Tag collision (this is when the signals from two or more tags overlap and interfere with each other)
- ii. Radio waves are relatively easy to jam or interrupt
- iii. It is relatively easy to hack into data transmitted by the tag
- iv. RFID is more expensive than a comparable barcode system

#### Magnetic ink character/reader (MICR)

- Can read characters printed in special ink
- Only certain characters written in a standard font can be read
- Primarily used for reading the characters at the bottom of a bank cheque
- These characters are converted into a form that the computer can understand and then stored in a computer file

#### Uses

- Processing cheques in banking operations

#### Advantages

- i. Offer greater security than OCR since the printed characters cannot be altered
- ii. There is no manual input, so errors are reduced
- iii. The magnetic ink characters can still be read even if somebody writes over them

#### Disadvantages

- i. Only certain characters can be read and the number of different characters is very limited
- ii. More expensive than other methods used in data entry

#### Optical mark recognition/reader (OMR)

- OMR is a device that can read marks written in pen or pencil
- The position of the mark is stored in the computers' memory after being read by the OMR device

### Uses

- Used to read questionnaires, multiple choice examination papers and many other types of form where responses are registered in the form of lines or shaded areas

### Advantages

- i. Very fast way of inputting the results of a survey. The documents are fed in automatically and there is no user output
- ii. Since there is no typing, there are more accurate than keying in data
- iii. They are more accurate than OCR method

### Disadvantages

- i. The forms needs to be carefully designed to make sure that the marks/shading are correctly positioned to gather accurate information
- ii. There can be problems if the forms haven't been filled in correctly; sometimes they have to be checked manually before being read, which is both time consuming and expensive.

### Optical character recognition/reader (OCR)

- OCR is the name given to software that take scanned text and converts it into a computer readable form

### Uses

- One of the most recent uses is the processing of passports and identity cards

### Advantages

- i. It is a much faster data entry system than manually keying in data
- ii. Since no manual data entry, the number or errors is also reduced

### Disadvantages

- i. The system still has difficulty reading handwriting
- ii. Still not a very accurate technique

OCR	OMR
Possible for customers to extend their answers to questions	The information obtained is limited to the choices offered in each question
Poor handwriting may cause reading errors	The position of the marks is compared to a template stored in memory

Used for converting printed documents to an editable electronic format	OMR reads the position of marks, so it is ideal for multiple choice exam papers
OCR requires a complex recognition system	Requires complex and expensive forms to be completed but the recognition system is simpler than OCR
Fewer how to full in instructions are needed	Requires more how to fill in instructions, it is easier to complete OMR than OCR
OCR is more accurate however there are still problems recognising all types of handwriting leading to inaccuracies	OMR is essentially a more accurate method for reading OCR

### Barcode readers

- Barcode readers are used to read information in the form of a barcode
- The readers are usually in the form of a barcode scanner and are often built into POS terminals in supermarkets

### Uses

- Used in supermarkets
- Used in libraries
- Used as a safety function in many companies to ensure electrical equipment is checked regularly

### Advantages

- i. Much faster than keying in data manually and fewer mistakes will be made
- ii. If used as a way of recording data, they can improve safety
- iii. They allow automatic stock control
- iv. They are tried and trusted technology

### Disadvantages

- i. Relatively expensive to the administrator
- ii. Not fool proof-barcodes can be swapped around on items
- iii. Can be more easily damaged than RFID tags or magnetic strips

### Quick response (QR) codes

- Made up of a matrix filled in dark squares with a light background
- Stores greater information than a regular barcode

- Used for advertising
- Can be read using phone camera or special applications on smartphones

#### Advantages

- i. There is no need for users to write down or key in a website address, it is done automatically by scanning a QR code
- ii. QR codes can store website addresses /URLs and is an effective method of advertising

#### Output devices

- Hardware devices that allow data to be output from a computer

### Monitors

#### CRT (Cathode ray tube) monitors

- Picture is made up of red, green and blue pixels with varied intensity to make up the range of colour interpreted by the eye

#### Uses

- Primary output for a computer, so the user can see immediately what they are typing in
- Used with light pens in CAD applications

#### Advantages

- i. The viewing angle is better than TFT monitors
- ii. They work with light pens in CAD applications

#### Disadvantages

- i. They tend to be rather heavy and present a safety hazard if not supported properly
- ii. They run very hot and can cause fires if left unattended
- iii. They consume more power than TFT monitors
- iv. They can flicker which causes eyesight problems and headaches

#### TFT (Thin Film Transistor) monitors

#### Uses

- They are used as the primary output for computer so that the user can immediately see what they are typing

- They are an integral part of laptop computers

#### Advantages

- i. They are lightweight and don't pose the same risks as CRT monitors
- ii. They produce less glare than CRT monitors and also emit less radiation
- iii. They consume much less power and don't generate as much heat as a CRT monitor

#### Disadvantages

- i. The viewing angle is not as good as a CRT monitor
- ii. Definition is sometimes not as good as a CRT monitor

#### LCD and LED monitors

- LCD monitors don't emit any light so some form of back lit technology needs to be used. Modern LCD monitors are backlit using LED (light emitting diode) technology. Before the use of LEDs, LCD monitors used CCFL (cold cathode fluorescent lamp) as a backlighting method

#### Comparison of LED and CCFL

- LEDs reach their maximum brightness almost immediately- there is no need to warm up to reach full efficiency
- LEDs give a whiter light, which sharpens the image and makes the colours appear more vivid, CCFL had a slightly yellowish tint
- LEDs produce a brighter light which improves colour definition
- Monitors using LED technology are much thinner than monitors using CCFL technology
- LEDs last almost indefinitely, making the technology more reliable and consistent
- LEDs consume very little power, which means they produce less heat as well as using less energy

#### Multimedia projectors

#### Uses

- Training presentations
- Advertising presentations
- Home cinema systems

#### Advantages

- i. Enables many people to see a presentation rather than crowding around a small computer screen
- ii. Avoids the need for several networked computers

#### Disadvantages

- i. Images can sometimes be fuzzy
- ii. Expensive to buy from the outset
- iii. Setting up projectors can be a little difficult

## Printers

### Laser printers

#### Uses

- They are used where low noise is required
- If fast, high-quality, high-volume printing is required then laser printers are the best options

#### Advantages

- i. Printing is fast
- ii. They can handle very large print jobs
- iii. The quality is consistently high
- iv. Toner cartridges last for a long time

#### Disadvantages

- i. Only really fast if several copies are being made
- ii. Colour laser printers tend to be expensive to run
- iii. They produce ozone and volatile organic compounds because of their method of printing and type of toner/ink used

### Inkjet printers

#### Uses

- Used where low volumes are required
- Used where high quality printing is required for single pages

#### Advantages

- i. High quality output
- ii. Cheaper to buy than laser printers
- iii. Very lightweight and have a small footprint
- iv. Don't produce ozone and volatile organic compounds, unlike laser printers

#### Disadvantages

- i. Slow output if several copies are needed
- ii. Can't do large print jobs
- iii. Printing can smudge if user is not careful
- iv. Can be expensive if used a lot

### Dot matrix printers

#### Uses

- They can be used in noisy environments and applications where print quality is not very important

- They are used in applications which use continuous or multi part stationery

#### Advantages

- i. They can be used in dusty, dirty or moist atmospheres
- ii. Carbon copies or multi part outputs can be produced
- iii. Very cheap to run and maintain
- iv. Easy to use if continuous stationery is required

#### Disadvantages

- i. Very noisy-not good in an office environment
- ii. Costs more than an inkjet printer to buy initially
- iii. Very slow, poor-quality printing

### 3D printers

- Exist in various sizes
- Used to aid manufacturing
- Uses inkjet technology
- Newer technology are using lasers and UV light to harden liquid polymers, increasing the diversity of the products being made

#### Process

1. A design is made using CAD software
2. Converted to format recognised by a 3D printer
3. 3D printer is set up to allow solid object to be made
4. The object is built layer by layer
5. The object is then prepared and left to cure

#### Uses

- Prosthetic limbs can be made to fit exactly onto an injured body part
- Making items to allow precision in reconstructive surgery
- In aerospace, manufacturers are looking at making wings and other aeroplane parts
- Fashion and art
- Making parts for items that are no longer in manufacture

#### Advantages

- i. Theoretically possible to manufacture any product and customise it
- ii. Allows prototypes to be produced at a rapid pace
- iii. It is both cost effective in terms of the size of the workforce and scale of manufacture
- iv. Able to produce precise items for reconstructive surgery, prosthetics and artificial organs



- v. Parts of machinery that are no longer made could now be manufactured using 3D printers

### Disadvantages

- i. Potential to make counterfeit items or items that infringe others' copyright
- ii. All new technologies in the hands of the wrong people can lead to dangerous or illegal activities
- iii. Potential for job loss if this technology takes over some types of manufacturing

### Speakers

- Can be connected to a computer or built into the computer frame
- Converts digital data from the computer to analogue data and the signal is amplified through the speakers

### Uses

- Output sound from multimedia presentations
- Play downloaded sound files
- Audio output of text on the screen (with speech generation technology) to help users with disabilities

### Control applications

#### Actuators

- Actuators are transducers
- Transducers are devices that change variations in a physical quantity into an electrical signal or vice versa
- Used to take signals from a computer and convert them into some form of motion
- As a part of the control process, digital signals are sent from the computer to an actuator to operate a device
- Usually conversion from digital signal to analogue signal is required first using a DAC
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- All the below are turned on or off by an actuator

### Motors

#### Uses

- Automatic washing machines (rotating the drum), cookers (to switch on fans), water pumps (central heating systems) and glasshouses (open windows and switching on fans)
- Control of robot arms in industry
- In computer to control fans, disk drives and DVD drives

### Buzzers

#### Uses

- Used in cookers or microwaves to tell the operator when the cooking process is complete
- Used in burglar alarm systems to warn off intruders

### Lights

#### Uses

- Security lights
- In glasshouses to control lighting conditions

### Heaters

#### Uses

- Automatic washing machines to heat up the water if necessary
- Automatically control the temperature in an oven or hot plate
- Control the heating in a central heating system
- Temperature control in an automatic glasshouse