



AS – Level ICT

IT05 14.7 Human / Computer Interface

- Recall different approaches to the problem of communication with ICT systems and discuss the resource implications of sophisticated HCI.
- Discuss the implications for customising software to develop a specialist HCI.

AQA Specification Criteria

An interface is defined as the point where two objects meet.

Human/computer interfaces provide the means by which the user tells the computer what to do and at the same time the computer can interact with the human user by producing a response.

These interfaces are important because they determine the ease with which the computer can be used. When the manufacturer of systems software or applications software gets it wrong, then using the software can prove very frustrating and the user will be less likely to buy one of their products again.

The standard interface for inputting data into the computer is the keyboard with the computer giving its response on the screen. This is not the only type of human/computer interface, although it is the most common. There are many other systems that make use of IT and need a different type of interface.

ACTIVITY 1:

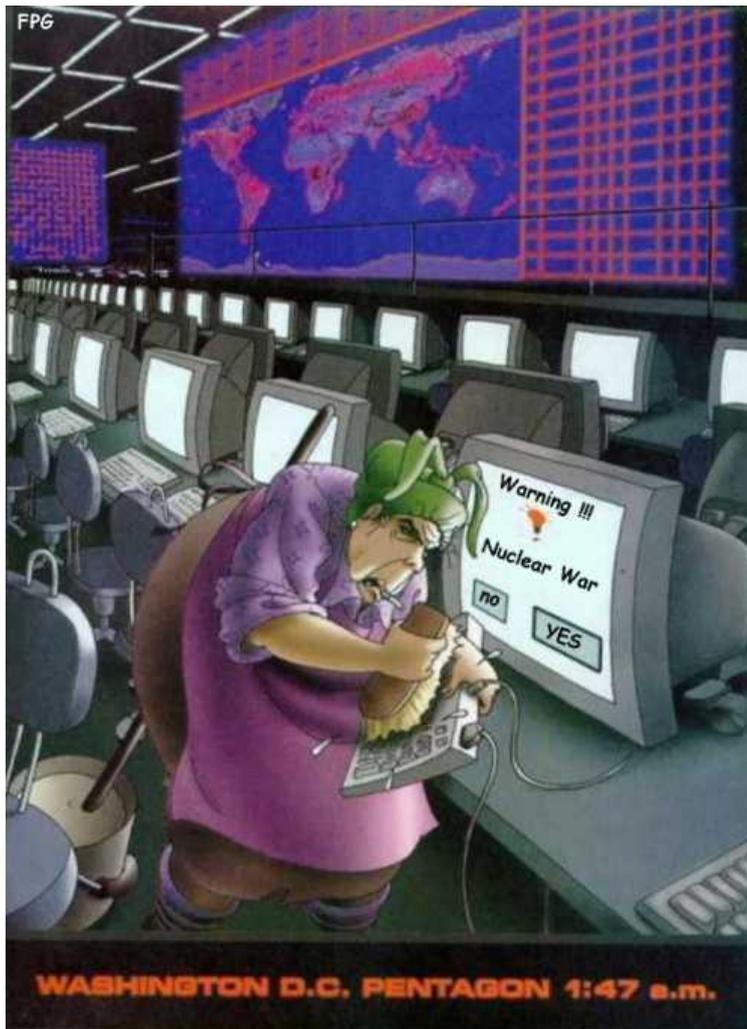
Discussion – how many different types of interface can you recall? What type of response does the interface give?

Process control screens, computer games, cockpit controls on fly-by-wire aircraft, information systems which can be used by members of the public, all make use of innovative user interfaces.

Improving productivity

Studying the human computer interface is important from the point of view of improving productivity and therefore job satisfaction.

Also in certain instances there is the need to ensure that work practices are safe i.e. that interfaces do not mislead the user or indicate incorrect actions.



In essence there is the need to facilitate an effective dialogue between the user and the computer.



ACTIVITY 2:

Choose one of the interfaces listed below and discuss how it is specifically designed for the task. Look out for any features of the interface which are specific to its use.

- A video recorder handset
- The interface for a games console
- The interface used in a cash dispenser
- The interface between the driver and the controls of a car.

The different capabilities of humans and machines

Humans receive information about the outside world using the senses of taste, touch, sight, smell and hearing. The ideal interface between humans and machines should incorporate as many of these as possible.

TOUCH. Multimedia applications make use of our sense of touch via the keyboard, mouse, joystick and touch-screen monitors.

SOUND. By using speakers, the computer is able to issue instructions or even encouragement to the user. Sound may also be used to input instructions or data to the system by using voice recognition software.

VR. Another interface, which makes use of as many of our senses as possible, is in the area of virtual reality. Virtual reality applications are programs that envelope the user within a simulated, three dimensional world of sight, touch and movement. With such an interface, the user is able to interact in a virtual world.

When user interfaces become sufficiently user friendly, communicating with computers will be almost like communicating with another human being. We are clearly some way from this at the moment but successive versions of new operating systems and applications software are making interfaces easier to use.

ACTIVITY 3:

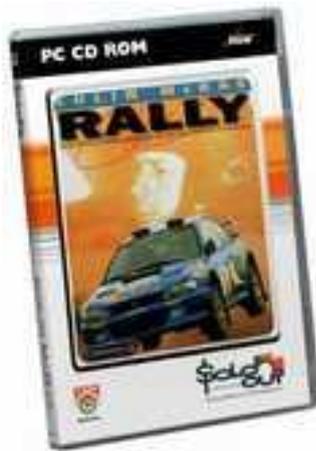
Explain the type of interface that would be most suited to the following applications:

- a) Looking at the flow of chemicals to a reaction vessel in a process control system.
- b) Seeing the speed of a car or the amount of fuel left in the petrol tank on a car dashboard.
- c) Giving the user of a cash machine instructions on how to use the machine.
- d) Enabling a customer to see the services offered by a bank in the foyer of the bank.

Choosing the right interface

Suppose you are playing a computer game, such as guiding a Rally car around a track. The game's manufacturer and you will want to make the game as realistic as possible, as this will enhance your enjoyment. The graphics showing the track and the other vehicles can be made realistic, as can the actual performance of the car (cornering, braking, accelerating and so on). This all adds to the realism of the game, but the thing that can let the game down is the human/computer interface.

The worst interface would be the cursor keys and other keys to steer the car, change gear, accelerate and so on. A better interface would be a joystick, although this is not ideal as cars are normally fitted with steering wheels, gear sticks and foot pedals. However you can now actually buy such interfaces to make controlling the car as realistic as possible.

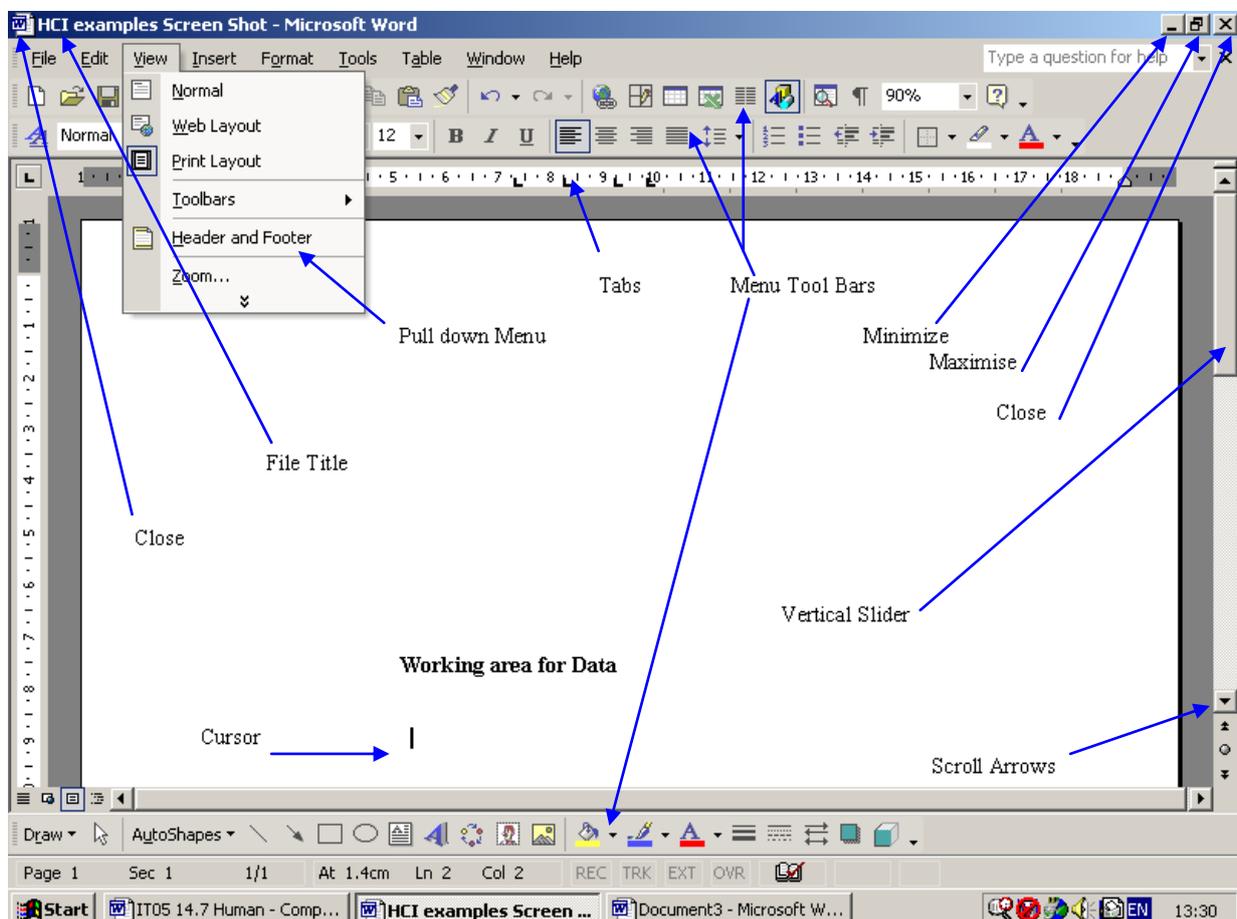


Graphical user interfaces (GUI)

A graphical user interface (GUI) is used by many manufacturers with their operating systems. Microsoft Windows 2000, ME, XP and the Apple Macintosh have GUIs. All the memory and file management activities are taken care of by these operating systems and it is possible for them to multi-task, with the user running more than one application at the same time. All these GUIs use a mouse to navigate around the screen; the mouse buttons are used to make selections from icons and buttons.

Dialogue boxes and pull-down menus are used as part of these interfaces. The work area is located in the centre of the screen and users are usually able to choose which toolbars, rulers and icons are displayed around this area. The user work area provides a moveable 'window' through which one can see the data being worked on; to move the data, the horizontal and vertical sliders at the side and the bottom of the screen are used.

A typical window is shown in diagram below what makes windows-based software particularly easy to use is that the interface is standardised across different applications. Some components of a typical window



Most windows computers will look similar to the previous screen shot and within any suite of applications there will be very identical icons, button bars, dialogue boxes and pull-down menus. This makes learning windows-based packages much easier.

A graphical user interface does more than simply control the hardware; it can be used by the programmer to influence how the user interacts with a program. In particular, it allows the programmer to standardise the way a program works. If a user knows how to open a document in a wordprocessing package, then if the interface is standardised, they will also know how to open a worksheet in a spreadsheet package.

So in summery, standardising programs makes it easy for the user to transfer skills from one application to another.

The main features of a GUI

There are a number of features common to all GUIs and these are:

- A mouse is used as the main input device. By moving a mouse on a flat surface, the cursor can be made to move across the screen; the left mouse button is used to make selections.

INSERT GRAPHICS HERE

- Overlapping windows are used. Many windows, even in different applications, can be opened simultaneously. You can therefore have a spreadsheet and a wordprocessed document on the screen at the same time and this makes it much easier if you are going to import data from one package into another.
- They make use of many graphics features. There are many graphical features incorporated into the design, such as icons, pull-down menus, toolbars, slide bars, selection boxes, dialogue boxes, etc.

ACTIVITY 4:

Discuss in small groups the following questions.

- a) All systems software and applications software have user interfaces. Some systems software makes use of a command line interface while others use a graphical user interface (GUI). Discuss the main differences between them.
- b) Discuss – In your opinion what are the five most important features of a graphical user interface?
- c) Find three advantages in using a GUI rather than a command line interface.

Clarity of structure and layout

If a graphical user interface is to be easy to learn and use, there are a few guidelines to bear in mind during its design and these include:

Reduce the mouse movements.

Put items such as icons and menu selections close together if they are likely to be used together.

Use pull-down menus.

The use of pull-down menus means that the screen is not cluttered with items to choose from, so the user has more of the screen available as their working area.

Design pull-down menus

The selections used most frequently should be situated at the top of the menu. This avoids the need to move down through the menu more than is necessary.

Include the facility to select which icons are displayed.

There are usually many more possible functions that have icons than there are icons on the screen and it is possible with most user interfaces to choose a selection that the user is most likely to need. As well as specifying which are shown, the user can usually put the icons in any convenient position on the screen.

The advantages of having a common user interface for different generic application programs

The advantage of most users having the same operating system is that people can move between computers and still know how to operate them. The same can be said of different generic packages, such as word processors, databases and spreadsheets.

Common commands

Where a number of commands can be issued using the keyboard, it makes sense to use the same combination of keys to perform the same task no matter which manufacturer has produced the software. This needs a certain amount of co-operation between rival companies and it can also mean that newer, improved user interfaces are harder to introduce. You have only to look at the standard layout of the typewriter keyboard to see how users like uniformity. Can you imagine what it would be like if every computer manufacturer decided they would have a different arrangement of keys on a keyboard?



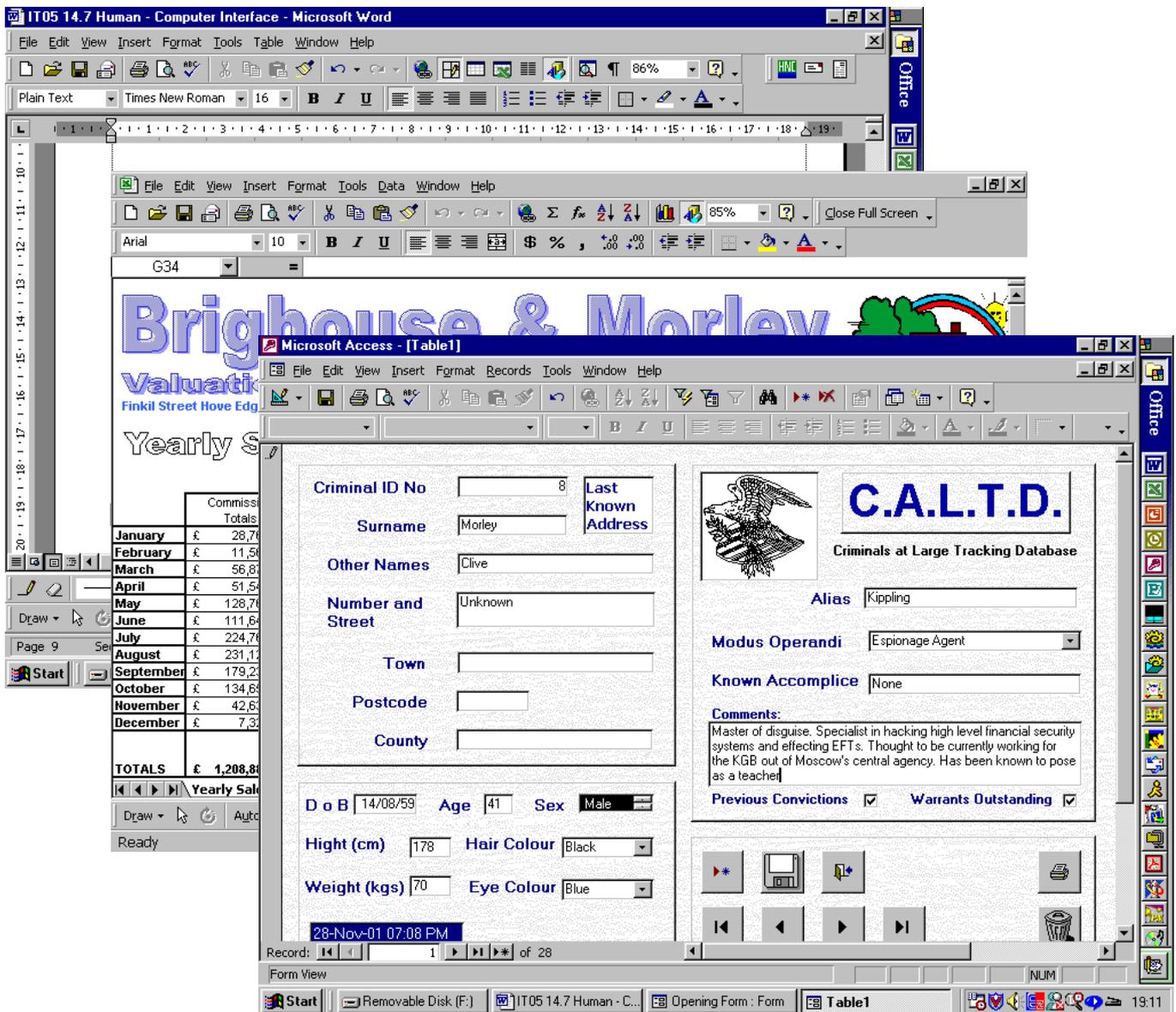
The present arrangement was designed originally to cope with the mechanical properties of the typewriter, but ended up making it slow. Other shapes of keyboard have been developed over the years; they are more ergonomically designed but people's resistance to making the change has meant that there are very few of them in use, even though most users find they are an improvement.

Increased speed of learning

Once a user has been trained on, and has mastered, one package, other packages with similar user interfaces are much easier to understand. The user will understand how to pull down menus and make selections using the mouse and also know what each of the icons means. An icon for print or save will usually look the same no matter which package is being used.

Features of user interfaces that are common to all packages

The more packages you look at, the more you will notice the similarities between them. It is not that the software manufacturers are copying each other, but that they are satisfying user demand by incorporating features common to many packages.



ACTIVITY 5:

Common user interfaces

Discuss some of the different user interfaces in different packages (if possible, from different manufacturers) and you will notice that there are many recurrent features.

Debrief

Interfaces from software created by the same manufacturer are usually quite similar, particularly if the individual software components form part of a software suite. Did you look at the following?

- The arrangement of the overall screen.
- The use of pull-down menus and buttons.
- The design of the icons.
- The use of colours on the screen.
- The order of the menu selections in pull-down menus.
- The operations that need to be performed when files are imported from another package.
- The way in which you change the font size or font type.
- The way in which the printer settings are changed.
- How you can run another task at the same time (i.e. multi-tasking).

Designing systems and interfaces appropriate to disabled users

Interfaces for people with sensory impairments must be aimed at those senses which are unaffected by their disabilities.

A visually impaired person has two problems with most common interfaces. First they cannot look at the screen to see the menus, icons, etc. that enable them to make a particular selection, and secondly, they are not always aware when a mistake has occurred. The usual graphical interface is difficult to use and it is better if commands are issued using the keyboard.

Before the introduction of the Windows operating system, an operating system called DOS (disk operating system) was used, which meant the user had to learn a series of commands to do certain things such as format a disk or copy a group of files. Many of these commands did not need to be typed in full, but could be issued using a single keystroke or a combination of keystrokes. The visually impaired user can issue DOS commands to the computer relatively easily. When hard copy output is needed, it is possible for an impact printer (such as a dot matrix printer) to produce the output on Braille which can be read by other visually impaired users.

Another approach is to use special software that converts the text or commands into speech. For example, wordprocessing software for visually impaired people enables the user to move through a document word by word, while the system reads them. By using this method, the user can detect any mistakes made. The user of this system also hears commands as they are issued, so mistakes can be detected and the command corrected.

Many users, particularly disabled users who have difficulty in pressing individual keys, may find speech recognition systems much easier to use. The main problem arises when what has been typed needs to be edited. There are, however, ways in which the user can direct the cursor for editing and then issue spoken instructions.

The importance to companies of adopting a common user interface

If you regularly work at a college or school, you will probably have to use lots of different computers in the course of a week. This means you are likely to experience some problems when using operating systems software or applications software.

The problems usually involve the previous user having changed some of the settings on the interface. For example, they could have changed the screen or character colours.

If you are using applications software, such as wordprocessing, there may be different margins set or toolbars showing on the screen. These are just some of the frustrations that occur when you have to share computers with other people.

Many commercial organisations do not have a desk for each of their employees; they consider it wasteful to do so because not all employees are working at their desks at the same time. This means that employees have to find a vacant desk with a computer if they want to do some work. So that changes to the user interface are not passed on to the next user of the system, companies make use of a network where the software is stored on the server. When a user logs on to the system they are presented with the same interface, and it is then up to them to change the settings for their own use during their log-in period, should they want to.

This avoids unnecessary calls to the help lines; most large companies operate, to sort out problems caused by changed settings.

Summary of the benefits of providing a common user interface between packages

- The operational basics of one application can easily be applied to other applications.
- Key commands can be found in the same place for each application.
- There is consistency in toolbars and menus.
- Dialogue boxes, customisable features and operational features are similar.
- On-line help is provided in each application in a similar way.

Other types of user interface

Sometimes, users need only simple interfaces, when the variety of tasks to be performed is quite limited, for instance, entering customer order details using a terminal.

We will now look at some other types of interfaces.

Forms dialogue

Forms on the screen are used in a similar way to paper forms. They enable data to be entered into the system in a pre-determined and structured way. The forms usually have the name of the data to be entered into each box at the side of the box and this tells the user exactly what they have to type in. If this is not sufficient, additional instructions can be added by way of an explanation. Forms can also have buttons added and pick lists that give the user a dropdown list of options to choose from. Check boxes can also be used, where the user can select one or more items by clicking on the appropriate boxes in a list. This arrangement is very popular when entering details into a database; if you do a database project you will probably have to design such a form for data input. Forms dialogue can be classed as either formatted or free format. The difference between the two is in the flexibility offered to the user. With formatted dialogue interfaces there are fewer ways for the user to enter data into the computer and for this reason they are better suited to novices. With free format dialogue the interface is more complex and there are lots of ways of entering data. It is important that the designer of the interface matches it to the capabilities of the user, since a simple formatted dialogue design can annoy an experienced user

with its lack of scope, while a novice could find overwhelming the choices in a free format dialogue system.

Command-driven interfaces

The main problem for users of command-driven interfaces is that to use them successfully, it is necessary to remember a large number of commands and also how to construct them. Although these interfaces often use help screens, in case you forget a command or need to look up the syntax, they are still very hard for inexperienced users to master. The users of command-driven interfaces have to learn a command language similar in many ways to a specialist programming language and which is almost as difficult to learn.

INSERT DOS COMMANDS HERE

Users usually know what they want to do, but they do not know how to translate this into a series of commands. For this reason command driven interfaces have become much less popular over recent years, and have been overtaken by graphical user interfaces.

Command-driven interfaces are also called command line interfaces because it is necessary for the user to type in a command next to the cursor on the line. Many operating systems such as MS-DOS (Microsoft disk operating system) and UNIX use a command line interface and in MS-DOS the user has to type ``C>DIR'` to obtain a list of the files stored on the hard drive. Once all the commands are learnt, a command line interface can be quite fast, but you may waste time looking up commands and syntax details or making mistakes and then having to correct them.

Here is a summary outlining the advantages and disadvantages of using a command-driven interface.

Advantages

- They are very powerful and the user can achieve a lot with a single command.
- They are very quick provided you are an experienced user.
- They are very flexible and you can alter the parameters to do different things.

Disadvantages

- They are quite difficult to learn.
- They are less suitable for novice or intermittent users.
- They sometimes use obscure abbreviations or keywords and syntax is important.
- They are prone to typing mistakes.

Menus

There are several different types of menu that can be used:

- Full screen menus
- Pop-up menus
- Pull-down menus.

Full screen menus

These are menus that take up the whole screen, which remain in view until the user makes a selection. Many opening menus for application packages are of this type.

Pop-up menus

These are usually brought up by clicking the right-hand button of the mouse; the user is then able to make a selection from a list.

Pull-down menus

To save space these menus are only shown if the user clicks on a particular item. To make a selection, the user clicks on one of the items in the menu. To cancel the operation, escape is pressed.

The potential for a natural language interface

It would be convenient if we had the same human/computer interface as the computers in science fiction such as Star Trek and 2001, A Space Odyssey, in which people could simply talk to computers in the same way as we talk to another person. Since this is the most natural way of communicating, such an interface is called a 'natural language interface'.

'Natural' in this context means human-like and the idea is to get computers to behave more like humans so as to make it easier for us to communicate with them.

The most important aspect of a natural language interface is that the computer should be able to understand what the user wants it to do without requiring correctly structured commands and data names in a particular order. All you should need to do is to express yourself clearly, either by typing or speaking to the computer.

Since people can say the same thing in a variety of ways, the computer would need to be able to interpret and understand what is being said accurately, and this is a major hurdle for developers of natural language interfaces.

One person might say 'Can I have the sales of Mars bars for March?', and another might say 'Give me the revenue details for Mars bars sold in March'. In either case the computer should be able to give the same details. A natural language interface also needs to be able to cope with misspelled words, bad grammar and slang, either 'understanding' them or asking the user for clarification. If speech recognition is used, the interface will also need to cope with mispronounced words, different regional accents, etc.

The use of a natural language interface to access a knowledge base is the foundation of the area called artificial intelligence.

Pointer-based interfaces

There are other up-to-date interfaces besides GUIs and these are called pointer-based or gesture-based interfaces. They work by using a pen-like stylus or pointer to interact with the computer. With some systems, you can simply write in ordinary handwriting using the stylus on a special pad which represents the input device for the system. These systems need special software called handwriting recognition software. In some systems, particularly CAD (computer-aided design) systems, the user uses a graphics tablet or pad and the stylus is used to point to certain shapes or commands on the pad. The advantage with this system is that it allows the user to use freehand, using the stylus like a pencil. This is much easier to control than a mouse.

INSERT GRAPHICS TABLET PICTURE AND TOUCH SENSITIVE SCREEN

Some pointer-based interfaces do not even have a stylus and they instead make use of a touch sensitive screen which can detect the pressure of a user's finger on the screen. You may have seen such devices being made use of in quiz machines. You can also see them in banks where they are used to present the user with a series of options and the user can make their selection by pressing the screen at a certain point.

Pointing devices

Pointing devices enable the user to move the cursor to anywhere on the screen and point to a tool, icon, menu selection or button. The commonest pointing device is the mouse which seems to come with any new computer purchased. The mouse is the part of the computer system that wears out soonest because it is usually mechanical and has moving parts which wear. Mice usually come with either two or three selection buttons for making selections and some have a small wheel in the middle.

INSERT MOUSE TYPES

As well as traditional mice, there are also some other pointing devices which are better suited to some applications.

The trackball [INSERT PICTURE OF TRACKERBALL](#)

If you turn an ordinary mouse upside down and rotate the ball using your hand, you have a simple trackball. Although it is quite difficult to use, after a while you get used to it. Trackballs are particularly useful if there is no flat surface on which a mouse can be moved and for this reason they are provided on laptop computers. Systems designed for members of the public or for children often make use of trackballs. One such trackball, called EasyBall, is designed specifically for very young children, so that they can learn to interact with the computer from an early age. It is also ideal for anyone who lacks the manual dexterity needed for using an ordinary mouse.

The touch-sensitive pad [GET PICTURE](#)

There are two types of touch-sensitive pad; the mouse pad and the bit pad. The mouse pad consists of a touch-sensitive pad which works in a similar way to a mouse, in that it senses the relative position of either your finger or a special stylus on the pad. By moving your finger (or the stylus) over the pad, the movement is transferred to the movement of the cursor on the screen. Mouse pads are useful when space is at a premium and for this reason they are popular with laptop computers.

The bit pad works in a slightly different way, by making use of absolute positioning. Unlike the mouse pad, if you move the pointer from one corner of the pad to the other, the cursor jumps from one corner to the other. This makes it quicker to use than the mouse pad since it is not necessary to move the stylus across the surface of the pad. The bit pad is ideal for drawing freehand on the screen since using the stylus on the pad is just like using a pencil or pen on paper.

Full size bit pads are ideal for drawing or painting. The pad also has icons from which certain tools and functions may be selected by touching them.

Speech recognition

Using speech to supply both instructions and data to the computer moves us nearer to the natural language interface. It allows humans to communicate directly with the system and although it can be used in a wide variety of applications, it has only become popular as a method of communicating with the computer via the operating system OS/2, or when inputting text into a wordprocessing package.

The main advantage with speech recognition as part of the user interface, is that there is no longer any need to learn commands or complex procedures. Speech recognition also avoids any need for difficult-to-use devices such as mice and keyboards.

Using speech recognition, the user has only to state what they want the computer to do. Of course, things are not that simple and there are a number of difficulties that need to be overcome. When speech recognition is used to issue commands, it is necessary for complex speech recognition software to understand what the user means, translate this into an actual machine command and then execute it.

Problems include being able to understand different kinds of voices (e.g. male and female) and different accents. In addition to these problems the system also has to deal with background noise such as telephones ringing or people talking in the background.

You may have already used a speech recognition system in the shape of a telephone service where the computer asks you simple questions and then reacts to the responses given.

Using speech recognition and a natural language interface means that users will no longer need to interact physically with the computer using a keyboard or mouse. Instead, as long as the computer system can hear them, this will be enough. Just think, you could ask the computer to load the wordprocessing software and create a new document, then dictate your letter while hanging wallpaper! This would also open up lots of possibilities to disabled people who could then interact with the computer more effectively

Speech recognition offers an improved interface for most people, who can generally talk faster than they can type. Also, if you tell the computer in general terms what you want, it takes a lot less time and explaining than it does typing the instruction.

Speech recognition will be particularly useful for the Internet since a user can simply describe what they want the computer to search for and an 'intelligent agent' will go away and look for the information.

There are some areas where speech recognition and the natural language interface may not be useful. For example, mathematical equations and programming steps are both difficult to describe using the spoken word. Handwriting recognition or a keyboard are more useful in these cases.

There are occasions, such as when you are preparing a confidential document, when it would be inappropriate to speak aloud, so some silent form of HCI would be needed. Another example is the selection of options from a list, in which case the options would need to be read out. A keyboard or mouse is better suited to this type of application.

Keyboards

When you buy a computer it comes with a keyboard and mouse (or other pointing device in the case of portables and laptops). Coupled with a screen, these provide the most usual interface. However, this arrangement does present a problem for users who only type slowly and even more of a problem for users who have never used a computer before. It is for this reason that other interfaces have been developed for these situations. Even when software makes extensive use of a GUI, you can often still use the keyboard to work the computer, using a combination of keys. For an experienced typist, removing their hands from the keyboard to use the mouse will slow them down considerably. Instead they can use a combination of keys (such as Ctrl and P at the same time).

Dedicated keys

A dedicated key is a key on the computer keyboard which is used for only one purpose. The purpose of the key cannot be altered using the applications software. The page up and page down keys are examples of dedicated keys.

Soft keys

A soft key is a key on the computer keyboard which may be used for different things by different packages. For example, the function keys F1-F12 all carry out different commands depending on which software is being used.

ACTIVITY 6:

variety of new terms have been introduced in this module, many of which may be new to you. It is important that you build up vocabulary which can be used when answering exam questions or writing project documentation

Write a definition for each of the following terms used in this section

- Interface
- HCI
- Graphical user interface (GUI)
- Icon
- Natural language interface
- Pointer-based interface
- Trackball
- Bit pad

QUESTIONS

1) A different human/computer interface would be needed for each of the following users:

- (i) a young child in a primary school,
- (ii) a blind person,
- (iii) a graphic artist.

For each user describe and justify an appropriate human/machine interface.

(NEAB, Module ITO2, Specimen Paper, q7)

2) A college uses a range of software packages from different suppliers. Each package has a different user interface. The college is considering changing its software to one supplier and to a common user interface.

- (a) Give four advantages of having a common user interface. (4)
- (b) Describe four specific features of a user interface which would benefit from being common between packages. (4)
- (c) Discuss the issues involved, apart from user interfaces, in the college changing of upgrading software packages. (8)

(NEAB, Module ITO2, May 1997, q8)

3) Speech recognition systems for Personal Computers are now becoming more affordable and useable.

- (a) State two advantages to a PC user of a speech recognition system. (2)
- (b) Give two different tasks for which a PC user could take advantage of speech recognition. (2)
- (c) Speech recognition systems sometime fail to be 100 per cent effective in practice. Give three reasons why this is so. (3)

(NEAB, Module ITO2, May 99, q6)