I have always wished that my computer would be as easy to use as my telephone.
My wish has come true.
I no longer know how to use my telephone.
Bjarne Stroustrup, designer of C++

Overview
Having looked at what an information system is we can now look at what makes these systems useable. Human computer interaction (HCI) is an area of study into how people use computers and other technologies such as mobile phones, digital cameras, software and operating systems. In this unit we will investigate:

- what HCI is
- the user and the difference between the user model and the program model
- usability and user friendliness
- forms of user interface
- design devices in HCI such as metaphors, idiom and affordance
- the ergonomic workplace.

Introduction to HCI
Imagine you are in the middle of doing some research for an oral you have to present tomorrow. You google a search term and come up with a result of 2 million+ links. The first site you click on to is full of writing, has no clear headings, and has no search facility. How long will you stay on this site before going back to Google to click through the next link – 10 seconds, 5 seconds, less? You have too much to do to waste your time on a poorly set up site. Studies have found that 50% of visitors cannot find what they want on a web site, and 40% of users who have had a negative experience on a site will not return to it. Web users have a low tolerance for poor usability; if they cannot get what they want immediately, they will click on.
Now think of a web site from the point of view of the provider. Say a start up company has a new product it wants to sell over the internet and it pays a developer $32 000 to build the site. After a month of operation, and very few sales, the company checks web usage statistics and finds that what visitors they have had, have clicked through in less than 5 seconds! This is obviously very poor for the company, and the web developer has not earned the fee charged. Why do some web sites hold a visitor’s attention while other sites are ignored?

The answer to this question is the basis of a whole area of study in the IT world. It has variously been called interaction design, usability engineering, user interfacing, usability design, user-centred interface design, and so on. We will investigate the topic under the heading Human-Computer Interaction or HCI.

HCI involves not only the usability of web sites and other forms of presentation, but also the design and implementation of software and hardware. It is primarily concerned with the communication or interface between a person and technology to make the device or program easier to use and more effective in action.

**Activity 2.1 – Look at me!**

1. Why do some web sites hold a visitor’s attention while other sites are ignored?
   a. Find out what click through rate (CTR) is a measure of.
   b. Briefly describe a negative experience you have had in visiting a web site.
   c. List some of the things that might turn a visitor off, when accessing a web site.
   d. List features that might make a site more user friendly.

2. a. What does the word *interface* mean in general use?
   b. How is the term *interface* used in reference to technologies such as computers?

3. Using machines often involves a two-way communication, human to machine, and machine to human. As an example, when you check your voice mail an automated voice will give you a list of options, while you, the user, press touch-tone phone buttons or access voice recognition software to make a choice.

   Complete the following table indicating the two-way human-machine communications that take place. Add two examples of your own.

<table>
<thead>
<tr>
<th>Device</th>
<th>Human to machine communication</th>
<th>Machine to human communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>voice mail</td>
<td>automated voice</td>
<td>voice recognition software</td>
</tr>
<tr>
<td>car</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>computer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. a Over the past 15 years the computer has undergone a radical shift. It has moved from a piece of machinery that just runs software to get tasks done, to a device that provides new ways for people to communicate, and delivers media content such as music and video.

Into which category, older usage (O) or current usage (C), would each of the following fit?:

- word processing (O)
- playing mp3s (C)
- web browsing (C)
- email (O)
- spreadsheet (C)
- database (C)
- gaming (C)
- chatting (C)
- filing (C)

b As the focus of the computer has changed, so has the character of the type of person who uses a computer. In what ways might users today be different from users of 15 years ago?

5. a Investigate web sites that feature poor design (e.g. webpagesthatsuck.com) and identify some of the features that contribute to a poor user experience with web sites or programs.

b Pick three examples of design faults. For each identify the fault and explain how and why it detracts from the usability of the site or program. If you can, suggest improvements or a better alternative.

The user

In investigating HCI we are interested in looking at making effective interfaces for computer hardware, programs and for web sites. The first thing in an investigation into HCI is to understand the people who use each of these technologies.

*User* is a general term to describe anyone who interacts with technology. The user can be a shopper pressing a touch-sensitive screen to get directions to a store, a browser on the web, a mobile phone caller, a network administrator managing five hundred computers, a teenager playing *CounterStrike*, a check out operator using a scanner, or any other person using an piece of technology.

The user is the most important factor in determining the design of any type of computer system. If the user cannot use the system, or the system makes it difficult for the user to achieve their purpose, then the system is at fault.

A key perspective to maintain in HCI design is that the system must be adapted to suit the user, and there should not be an expectation that the user will adapt to fit the system.

Types of user

Users of computers can be placed into three broad groups:

- beginners (newbies) – these are the users who have difficulty with basic operations such as using a mouse (double click, drag and drop, precise positioning), who do not understand the basic concepts (e.g. overlapping windows), who do not comprehend
the file system in use, or do not appreciate the conventions (e.g. in gaming or social networks)

- intermediate users – these can start the applications and games they commonly use, can carry out everyday functions such as save, navigate, and send attachments, but do not have a real grasp of how the computer functions
- experts – these users are fluent in computer operation, have a good understanding of how the computer works, and can effectively manipulate the environment of the technology in use.

Any developer of a technology must keep the end user in mind. Most users are in the intermediate stage, therefore it is best to design for the intermediate user. At the same time the developer must also allow for the beginner and the expert. The expert user wants efficiency, the beginner does not want complexity.

In addition the developer has to allow for other less common, but still important, groups of users. These include non-English speakers, users from different cultures, or users with disabilities or limitations. On the other hand there are the computer “geeks”, the experts or enthusiasts who are very skilful at handling technology. Finding a balance between the needs and demands of all these different groups of users is one of the bigger challenges that developers must face.

User model

Each user links to the technology on a one-to-one basis. In doing this they build up their own mental image of how they expect a device to work. Such an image is sometimes described as a virtual environment or a user model.

The user model is the user’s mental concept of how the device behaves. It is based on their experience of using the technology and consists of expectations of how the hardware, software or web site will act. By developing their own picture of what is going on, each user makes their own sense of the device they are working with. It does not matter if the user has an accurate model of the technology, as long as their model works for them in their situation. The user model forms part of the external view of the system described in unit 1.

In contrast to the user model is the program model which is how the technology actually behaves and works. This is the view of the technology as seen by the person who designs and makes it.

The user model will probably not match the program model

To show how the user model can be different from the program model of how the technology actually works we will look at an example:
Say a user is familiar with *Microsoft Word*. In Word if you insert an image into a document the image becomes part of that document.

This user now goes to a web authoring program. Perhaps the menu interface is similar and so the user expects that when they inserted the image into a web page the image would be embedded just as it was in Word. Unfortunately this may not be so. Usually there is a link to the image, but it is stored separately from the web page.

If a user transfers their user model for Word across to the web authoring program they could become confused or even lose data.

For example you can delete the image file from disc after inserting it into a Word document and it still appears in the document, but if you did this with the web authoring program you might lose the image.

The gap between the user model and the program model becomes important later when we start to look at designing the interface to programs or information systems.

**User focus**

The final aspect to be aware of is that users are goal-focused, and not task-focused.

A goal is what motivates a person to do something, the task is the job to be done. A person wants money (goal) so they go to work (task), a player wants to get on the team (goal) so she goes to netball practice (task), you want to eat (goal) so you cook a meal (task). We do what we have to, to get what we want.

If a developer confuses goals and tasks then he or she may develop an impressive piece of technology, but one that will not do what the user wants. To successfully design an interface to a technology a developer must identify the user’s goals. This is usually accomplished by talking to users and carefully analysing their answers.

A good example of this occurred during an upgrade to *Microsoft Excel*. The developers were convinced they could increase sales if they added more functions and power to the spreadsheet application. However, through user interviews and during usability testing, the developers found the majority of users were using Excel, not for advanced statistical functions and pivot tables, but rather to process lists! These turned out to be lists of names or organisations, that are then sorted, grouped, totalled, averaged, and so on. This was not what was expected at all.

When the Excel upgrade went ahead, instead of the addition of more esoteric functions, it was given improved list processing abilities. The developers had listened to users’ goals (what they wanted to do) rather than thinking of tasks that might have been done with the software. It was tempting to focus on the dazzling technologies available, but the developers were not sidetracked from the purpose of providing a tool to meet user goals. The goal must come first, then the task.

**Activity 2.2 – Useful**

1. a Identify the three broad categories of users of computers. Give a brief description of each.
   b Into which category would each of the following most likely fit:
      * network admin
- office worker
- high school student
- experienced gamer
- 65 year old pensioner
- a game moderator.

c It has been said that a developer should imagine the typical user as intelligent, but very busy.
Explain how this point of view would help generate an interface that would meet the needs of as many users as possible.

2. Give an example of a situation in which a poorly developed interface might not meet the needs of each of the following users:
   a A recent immigrant from Afghanistan who speaks little English.
   b A younger student with poor fine motor skills, e.g. has difficulty moving fingers precisely.
   c A refugee from Sudan who has been resettled in Australia. (The Sudan is a country with little electricity and very few computers.)
   d A colour blind web site editor.

3. a What is meant by the term *user model*?
b Explain, with an example, the difference between a user model of what is happening with a piece of technology and the underlying program model.
Your answer could involve any technology such as a TV remote control, a computer game, a mobile phone, a database, or anything else where the user’s perception of what is happening differs from the underlying function.

4. a What is the meaning of the term “user” in the drug culture?
b How can the actions or behaviour of some computer users be likened to that of a drug user?

5. a What is the main task a motor vehicle is used for?
b For each of the following identify what might be the purpose or goal of owning a motor vehicle. Next suggest a type of vehicle that would meet this goal.

<table>
<thead>
<tr>
<th>Driver</th>
<th>Purpose or goal</th>
<th>Suitable vehicle to meet goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 year old male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mother with young child</td>
<td></td>
<td></td>
</tr>
<tr>
<td>delivery driver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>race driver</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

c In your own words explain the difference between a task and a goal.
Give an example of a technology in use to illustrate your answer.
Usability

Now we have identified the user we will look at what makes some technology and programs more useable than others.

A vital part of programming is preparing an application that the user is comfortable running. Whether the program is a computer game or an accounting package, the person operating it can easily be distracted from what they are trying to do, or worse, put in a position they cannot control. It will be part of your task in programming or in developing an information system, to create a look and feel for your programs that will put users at ease.

User friendly

The design of a piece of technology must be done in cooperation with the end users so that the completed system is user friendly. It is important to put people oriented decisions before hardware or software based decisions because the user is the most important single element of the system. If the technology is not user friendly then the user is hampered in using it effectively as a tool to complete tasks.

A user friendly system is one that:

- has an intuitive user interface – this means that the user should be able to work out the function of the technology for themselves
- is consistent and predictable – by using the same ways to carry out the same functions the user can become comfortable and familiar with the technology’s operation
- is easy to learn – no matter the level of interaction, the user has at some stage to be taught how to use the technology; the more casual the approach, the simpler the learning must be
- is easy to use – controls should be easy to get at and not be difficult to work; users also find it easier to understand a graphical (picture based) interface in using the technology
- is fault tolerant and user proof – a fault tolerant technology will not “crash” if the user does something unexpected, while a user proof technology is one that will not permit the user to enter unreasonable values (e.g. Age: -153)
- is error free – the technology runs to completion correctly at all times
- has user assistance – messages on screen, on-line help, tutorials and manuals will support the user when they get into an unfamiliar situation.

While developers should aim to make a system as user friendly as possible it should also be recognised that what is intuitive for some is not as obvious for others, for example for users from a different background or culture.

User interface

One of the main factors in user friendliness is the usability of the user interface (UI). A poorly designed interface will make the user feel stupid, cause errors, slow users down, or bore the user. On the other hand a good UI is easy to use, enables maximum user efficiency and effectiveness, and is non-threatening.

To develop an effective UI developers use guidelines similar to the following:
• simplicity – avoid clutter and make important features or functions obvious
• stay in the real world – use plain language and concepts familiar to the user, rather than computer-based terms
• provide feedback – the technology should always keep users informed about what is going on
• forgiveness – give users room to explore without dire consequences; always provide a way out and help users recognise, diagnose, and recover from errors
• autonomy and flexibility – give the user control over how the interface appears and works
• efficiency – let the user do what they want with the minimum of operations; do not include information that is irrelevant or rarely needed
• limit text – users do not read (manuals, dialogues, help messages, instructions, EULAs); use as few words as possible
• recognition rather than recall – make objects, actions, and options visible so the user does not have to memorise them; do not ask users to remember things that the computer can remember (e.g. use menus with a range of choices, provide a list of available files to open)

Which of these two views of a list of image files is more usable? Why?

• reduce excise – eliminate unnecessary activity required to get to a goal that does not contribute to the goal e.g. unnecessary clicks, dialogues or questions
• provide for expert users – e.g. use accelerators such as Alt+C for copy
• provide for non-expert users – do not require good mouse skill, allow for beginners or people with poor motor skills.

Allowing for all users
Not all users can use technology with equal ease. Some users have limitations that reduce their ability to interact with the computer or other device they are using.
Limitations may exist as:
• visual impairment – users who are colour blind have difficulty distinguishing some colours from others, or even from seeing colours altogether; some users have lost some or all vision
• aural deficiencies – those who cannot hear properly or at all will have difficulty picking up cues that are linked to sounds
• left-handedness – more than 10% of the population are left handed, but many devices are designed for right handed people (e.g. the number key pad on the standard computer keyboard)
• poor motor skills – young children or those with muscle or nerve related disabilities may not have the required fine or gross motor skills needed to operate devices such as a mouse
• cognitive difficulties – some users cannot process information as quickly as others
• poor language skills – this will include those for whom English (or the language used) is not their native tongue
• cultural – people from different cultures have a different social background and may not be familiar with western ways of presenting ideas or information
• experience – users who come from a deprived or a less prosperous background such as refugees may have had little exposure to technology
• age – older users have different ways of visualising, and work from a different concept base than younger people.

There are also other allowances that have to be made when designing for general use. These include making provision for those with older equipment or programs (old browser, slow connection, limited memory, low resolution screens, etc.), or those working in difficult conditions (noise, glare, distractions, etc.).

Activity 2.3 – User friendly

1. Prepare a table like the one below. Complete column 1 with a list of 10 technologies you interact with:

<table>
<thead>
<tr>
<th>Device</th>
<th>Effortless to use</th>
<th>Easy to learn</th>
<th>Enjoyable to use</th>
<th>Usability</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mobile phone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mp3 player</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X-Box / PS2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a  In column 2 tick those that are effortless to use.
b  In column 3 tick those that are easy to learn to use.
c  In column 4 tick those that are enjoyable to interact with.
d  Finally, in column 5 record the usability of each of these technologies. Use your own rating system or score to grade them in order of usability.

2. Look at you answer above and suggest some of the factors that might make certain products easy to use, effective, and satisfying.
3. a List the factors that make a system user friendly. 
   b Pick the three of these factors that you think are the most important. Write a sentence 
   on each explaining how it contributes to the user friendliness of either hardware or 
   software. 
   c Pick a program you have used (e.g. a game) or a piece of hardware you commonly 
   use (laptop, mobile phone, digital camera) and use the three factors you identified 
   above to discuss how user friendly it is. 

4. a It has been found that two of the products that cause users the most problems are 
   photocopiers and the programming function on VCRs. Why might this be so? 
   b One reason photocopiers, VCRs and other devices can be frustrating is that they were 
   probably designed without the end user in mind. They were engineered to perform a 
   set of functions rather than to be easy to use. The developers were task focussed 
   rather than goal focussed. 
   i Describe a frustrating device you have used (e.g. mp3 player). 
   ii Identify a goal you had in using the device that was not met by the developer. 
   iii How would you improve the design so that the device was easier to use? 

5. In the past every program had its own way to exit, e.g. Ctrl+X, Esc, Ctrl+Q, Quit, Exit, 
   and so on. Users had to memorise the specific method for each program they used. 
   a How do users close a window or application on the computer you use? Is there more 
   than one way to do this? 
   b Is this the same for all programs? 
   c Which aspect of user friendliness does this fulfil? 
   d How does this aspect help develop a user model. 

6. Excise is any action that is needed to reach a goal, but does not contribute to the goal. In 
   other words any unnecessary or wasted actions. 
   An example of excise is the requirement to cancel a dialogue box that pops up to ask if 
   you are sure you want to do something you have just told the computer you want to do. 
   Excise distracts users and wastes time. 
   a Identify the user goal, or possible goal, in each of the following situations that contain 
   excise: 
<table>
<thead>
<tr>
<th>Situation</th>
<th>Excise</th>
<th>Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>preparing dinner</td>
<td>wash dirty dishes</td>
<td></td>
</tr>
<tr>
<td>barbecue</td>
<td>mow lawn</td>
<td></td>
</tr>
<tr>
<td>access Internet</td>
<td>configure modem</td>
<td></td>
</tr>
<tr>
<td>where is this file?</td>
<td>Search dialogue options</td>
<td></td>
</tr>
<tr>
<td>how do I do this?</td>
<td>re-indexing of Help file</td>
<td></td>
</tr>
<tr>
<td>game setup</td>
<td>cancel unneeded options</td>
<td></td>
</tr>
</tbody>
</table>
   b Identify three other situations in which excise restricts you in achieving a goal.
7. What specific factors should the developer of a new technology keep in mind for each of the groups below. For your answer you might like to focus on one particular technology such as a new mobile phone, a PDA, or a specific piece of software such as a computer game.
   a. Colour blind users.
   b. Users with visual impairment.
   c. A user who has difficulty hearing.
   d. Users with poor motor skills.
   e. Those who might have cognitive difficulties or poor language skills.
   f. Older users
   g. Immigrants from a non-English speaking background.

**Activity 2.4 – Investigating useability**

A user interface is well designed when it behaves exactly as the user expects it to. In this activity you are going work in pairs to look at a simple piece of software to investigate its usability.

1. Start MS-Paint (or a similar simple “paint” program) and develop a simple drawing.
   As you do this talk to your partner about what you are doing, how you do it, and how easy it is to do. Verbalising is a useful aid in determining how you interact with the program and will help you develop your user model.
   Note also what information or feedback the program is providing to you the user.

2. Colour in parts of the drawing and add some text.

3. Save the drawing and then answer the following:
   a. Make a list of the different sorts of things you could do with the program.
   b. How many different ways could you interact with the program (menu, keyboard, etc.)?
   c. In using the mouse how easy was it to:
      - position it exactly
      - draw a straight line
      - join one line to another with no gap or overlap
      - draw a neat rectangle or ellipse
      - draw a smooth curve
      - fill in colour.
      Comment on how a beginning user would manage the mouse in this program.
   d. List as many different forms of feedback as you can that the program provided to you. (There should be at least five.)
Were any functions in the program fiddly or inefficient?

How easy was it to correct errors?

Were the basic functions of the program easy to learn to use?

Why?

Were the advanced functions easy to find and use?

What is the most complex type of drawing you think this program would be able to produce? Indicate a point on the following continuum to indicate this:

<table>
<thead>
<tr>
<th>childish</th>
<th>representative</th>
<th>technical</th>
</tr>
</thead>
<tbody>
<tr>
<td>sketch</td>
<td>picture</td>
<td>blueprint</td>
</tr>
</tbody>
</table>

4. Identify any excise you found in the program.

5. What changes or improvements could be made to this program to make it easier to use,
more efficient, and more satisfying for users?

6. The UI of any program can constrain thinking; users can only follow the options provided
by the designer and developer of the program.

a Does the paint program you have used have limited options for drawing?

b In what ways are users directed along set lines of development.

c What constraints does this place on thinking and expression?

Forms of UI

The user interface (UI) is the means by which a user communicates with an piece of
technology. It is the link between person and machine.

A computer works in machine code, a language of components being switched on or off,
polarised or not-polarised, charged or not charged. These are usually represented as a series of
1s and 0s such as 0011 0001 1110 1010 0101, which are meaningless to people. Users on the
other hand need words or pictures that they can understand so that they can communicate with
and control the computer.

The interface between person and machine is provided by both hardware and software. The
hardware interface includes the monitor, keyboard, mouse, speakers and so on, while the
software interface is the form of interaction the operating system and programs provide. This
interface can be graphical (picture based), menu driven, or another format.

The UI is also known as an abstraction barrier – a way of screening the everyday user from the
complexities of how the technology itself operates.

System interfaces

The most common interface nowadays is a graphical user interface (GUI — pronounced
goopy). This format consists of a series of pictures or icons that represent the various tasks or
programs that can be run. The user points to the required icon using a mouse and clicks to
activate it. The user may also click on an object to change it, or drag it to a new place.
A GUI is very easy to learn to use because the user sees an image of what is happening, which in turn helps to build the user model of the technology. Examples of GUIs include *Windows 7*, *Linux X Windows*, and *Macintosh System X*.

An alternative (or addition) to a GUI is a *menu driven interface*. In this the user is given a list of choices (the menu) and then makes a mouse click, or types in the letter or number chosen to carry out a task.

Menu interfaces are easy to use but are inflexible in that the user is restricted to only the choices offered. They can also be annoying in attempting to find a specific option in a complicated menu system. Menu interface examples include the applications in the Adobe suite and the start-up options of many games.

The current versions of MS Office use a *ribbon interface* which is a combination of graphical icons arranged in menu-like tabbed groups.

Less common nowadays are *command driven OSs* such as the *MS-DOS* that ran computers for many years. In these the user types in a letter or a word from the keyboard that is then translated into an instruction the computer carries out. These interfaces are quick to use but are difficult to learn as all commands have to be memorised. *Unix*, the basis of the Internet, is command driven.

A further way of allowing users to interact with a technology is the model used for web (and other) browsers. These grew out of earlier frame based interfaces used by programs such as HyperCard. By clicking on hyperlinks users can move between different pages, documents or images.
In addition there are other interfaces. These include:

- gesture interfaces for game consoles such as on the Wii or Kinect
- spoken language where the computer can understand words and commands
- pen based computing on tablet computers or PDAs
- graphic tablets used to input drawings or to control animations
- finger based interfaces on mobile phones and pad-style computers
- touch screens used at point of sale in restaurants and shops, or for display in shopping centres or museums, and
- virtual reality.

Software interfaces

In addition to how commands are given to a device there are also differences in the way a program can be presented to a user. For example the user interface in word processing has progressed from embedded commands to WYSIWYG.

Early word processors such as WordStar required the user to embed formatting commands into the document. For example in the following the word new:

... this was a <italic-on> new <italic-off> version ...

would appear in italics when printed:

this was a new version

Current word processors let users see how a document will look as they type it. This has been described as WYSIWYG – what you see is what you get.

Microsoft is now proposing a new interface called Results-oriented UI. In this model instead of trying to remember where all of the 1 500+ commands of Word are on the ribbon, users will be given examples of already formatted documents they can browse through to choose the look they want. The user specifies the desired result and the document is made to look like that.

Results-oriented UI is planned for upcoming versions of Office. Current versions of Publisher already have hundreds of templates users can base their document on.

Activity 2.5 – Interfacing

1. a Identify five different functions a mobile phone can provide.
   b How does the user interact with these functions? Identify both physical and visual interactions.
   c What is an abstraction barrier?
   d In what ways does the mobile phone interface provide an abstraction barrier between the actions the phone carries out and the person using it?

2. a What advantages are there to using a GUI such as Windows 7 to manipulate files on a computer?
   b What advantages are there in using a command line interface such as MS DOS or Unix to manipulate files on a computer?
3. A menu interface such as used in some applications has some advantages and some disadvantages. Identify two of each.

4. In what ways are the actions of a mouse different between its use in MS Word and its use in a browser such as Internet Explorer or Firefox?

5. In what ways has the use of gesture interfaces on game consoles such as the Nintendo Wii or Xbox Kinect altered the way users interact with games.

6. Visit www.ted.com and explore the variety of new interfaces available such as Jeff Han’s touch screen.
   Write a paragraph describing one of these interfaces and exploring its potential.

Design devices

Now that we have a general understanding of the user and usability it is time to start looking at some of the devices designers use to make an interface more intuitive. Before we do though we must recall the distinction between the program model and a user model of a given form of technology.

Earlier we looked at how users form their own image or concept of what is happening with a technology they are interacting with. This view is known as a user model of what is happening to distinguish it from the program model of what is actually going on.

If a user is copying files using a GUI they are shown a representation of a group of files being dragged from one folder to another (see image page 42). This is the user model. In actual fact only the links to files on the computer’s hard drive are being updated. The files themselves do not actually move; only the pointers to them are changed. This is the program model.

The workings of a computer are complex and it would be an unnecessary distraction for users to be constantly aware of them. For this reason developers provide an abstraction barrier to shield users from the program model. They use devices such as metaphors, idioms and affordances to help the user develop a workable user model.

Metaphors and idioms

In language, a metaphor is where a word or phrase is used in a different context than normal to suggest a likeness, e.g. a sea of troubles or throwing light on a subject.

In computer terms a metaphor is a representation of a real world object or action in a device or program so that users can associate the function with things they are already familiar with.

Examples of metaphors include:

- an on-screen button – when the mouse clicks on the button it appears to go in and an action is carried out, just like a real-world button
- the system desktop – in a way similar to a real desktop, users of GUI operating systems can place programs, folders and documents on the desktop until they need them; these can be moved around or used as required
- folders – a manila folder holds sheets of paper; a computer’s folder holds documents
Human-computer interaction

- page tabs – these are labels that can be clicked on to access a different display or range of options similar to the tabbed folders in a filing system

- recycle or trash bin – most GUI operating systems have a desktop icon that resembles a garbage bin into which unwanted programs and files can be dragged to be disposed of.

An *idiom* is a colourful way of expressing something, e.g. *it’s raining cats and dogs*. A computer idiom is similar to a metaphor, but rather than being based on an existing concept, it creates its own image that the user can relate to and recall.

Examples of idioms include:

- the scroll bar – this has no real world equivalent but once a user is shown how it works they can easily remember and use it
- icons – small pictures that represent functions or actions such as print or undo
- a magnifying glass – where clicking on the icon causes a zoom in or out

The use of metaphors and idioms can help users form their model of how the technology works. A good metaphor or idiom can help make the interface more intuitive. On the other hand a poor metaphor can confuse and hinder a new user. The desktop metaphor used with operating systems is not obvious. (Perhaps it is more of an idiom than a metaphor.)

**Affordance**

*Affordance* is a quality of an object whereby its function, what it does, is clear from its design or appearance.

A swing door may have a handle on one side and a metal plate on the other. The handle implies “pull”, the metal plate implies “push”. These are affordances. The term can also be used as a verb, e.g. the metal plate affords how to place your hand to push the door open.

In a GUI buttons have a 3D effect. As you click the mouse on the button its appearance changes so that it appears that it has been pushed in. This is an affordance.

An example of a common piece of equipment with poor affordance is the plastic CD or DVD case. To open a stiff new CD cover the hands and thumbs must be placed in the correct position. A person who has never opened a tight new CD case before is given no clues as to how to position their hands. Forcing the cover open in the wrong way can crack the case.
It is interesting to look at the design of small digital cameras. Some have no affordances at all – the user is given no guide as to where to place their hands. In taking pictures the user may place a finger over the edge of the lens, over the redeye reduction flash, or over the focus distance meter.

A well designed camera has moulded hand grips which give good affordances. The grips position the hands and fingers so that they hold the camera steady, and do not get in the way.

Which of these two has the better affordances?

The hand grip of the camera on the right serves no photographic function. It is designed this way simply to get the user’s hand in the correct position (and away from the wrong position). Note also the positioning of the buttons on the side of this camera. These are in just the right positions for the user’s left thumb to access them when holding the camera correctly. (This of course assumes the camera operator is right handed! If not then the affordances do not apply.)

An example of a poor affordance where the program model did not meet the user model is the old control panel on Macintosh computers.

(The following example and images are from User Interface Design for Programmers from www.joelonsoftware.com)

In this dialogue the user has to click on the control item icon on the left to bring up a range of choices for that item on the right. Here the user has clicked on ApplFont and has selected Geneva.

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Unfortunately many users did not see the connection between the panel on the left and the list of choices on the right. They did not even realize that the panel on the left could be scrolled to show more control items.

While experienced users (and the original programmers) had no trouble, it was found that only 30% of ordinary users understood and could use the dialogue. This means that the user model for less than 1 in 3 matched the program model.

Rather than try to force the program model on users the interface was redesigned using the metaphor of page or folder tabs that you might find in a book or filing cabinet.

This tabbed dialogue has good affordance. The user can see they have six different groups of items they can go to, it is clear which tab they are on, and it is obvious how to switch to a different set of items.

In testing Microsoft found tabbed dialogues had 100% usability. This is an amazing statistic. It means the affordance was so good that every single user was able to apply the metaphor and was able to work out how to use the tabbed dialogue.

Activity 2.6 – Metaphors, idioms and affordances

1. a Explain with examples the difference between a metaphor and an idiom.
   b Pick a metaphor or idiom applied in a technology you use, and explain how it helps make the interface more intuitive.
   c Pick another metaphor or idiom and explain how it might confuse a new user.

2. Microsoft uses the metaphor of a desktop for the Windows interface. Is this a good metaphor?
   Some suggest it is not. Its use is not intuitive or obvious, and has to be explained to new users. The Windows desktop is vertical (more like a fridge with magnets), rather than flat like the surface of a desk, and how many desks have a rubbish or recycling bin on them?
   What metaphor could be used in place of the desktop concept? Suggest something everyday users would be familiar with. Explain how the interface would be presented.
3. Compare a real calendar with the computerised calendar in a program such as *Outlook*.
   a) Is a metaphor or idiom used? Explain your answer.
   b) In what ways might the program model be different from the user model?

4. a) What is meant by an affordance?
   b) Give two examples of your own where affordances are used with technology.

5. Look at the shut down dialogues from Windows 98 and Windows XP:

   ![Win98 Shutdown Dialogue](image)
   ![XP Shutdown Dialogue](image)

   a) What metaphor (if any) is used for each of the dialogues?
   b) Are there any affordances in either dialogue?
   c) In each situation what is the default action, i.e. what will happen if you just press *Enter*?
      How easy is it to tell this in each dialogue?
   d) How many mouse clicks will it take in each dialogue to force a restart?
   e) Although not shown above the XP shut down dialogue is brightly coloured. Does this help or hinder a user?
   f) Of the two shut down dialogues which do you think has more usability, and why?

6. The ceramic stove top shown below has four electric elements (heaters) with four associated controls. From the design it is not clear which control belongs to which element.

   a) Redesign the layout of the elements and the controls to clearly link each.
   b) One solution might be to place each control next to each burner. Why would this not be efficient?
   c) What problems could using words or labels in a design solution lead to?
      In your answer consider factors such as language (e.g. selling the cook top in non-English speaking countries in Europe or in SE Asia), or people who have difficulty determining right from left.
d In your solution did you consider safety? Ceramic stove top elements do not glow red when hot. How can you ensure the user knows an element is on?

e Looking at you answers to the above amend your design solution to allow for efficiency, language and safety.

f Identify any metaphors, idioms or affordances you have used in your design.

g Look at solutions from others in your class and decide which is the best interface and why.

7. What is wrong with the following design for buttons in James Bond’s latest car?

8. To look at some other examples of poor design go to www.baddesigns.com.

Make a list of the factors that contribute to poor design.

**User centred design**

Suppose you are going to design the interface for an mp3 player that will enable users to handle their collections of songs, videos and pictures. Where do you start?

Would you begin by sketching out how the interface for this mp3 manager might look, work out how the system architecture will be structured, or even just start coding the interface?

Alternatively, would you start by asking users about their current experiences of saving mp3s, look at existing media players and, based on this, begin thinking about why, what, and how you were going to design the interface?

Which would be the better approach?

To answer this question we will look at a key principle of UI design:

*A user interface is well designed when the program behaves in exactly the way the user expects.*

or to state it in a different way:

*A well designed UI is when the program model is close to the user model.*

This may sound simple, but it is really difficult to achieve. It means the program must be adjusted to fit the user, and we should not expect the user to conform to the designer’s idea of what is needed.

It is necessary to change the program model to meet the user model, and not the other way round. Not only is it unreasonable to expect users to conform to some pre-conceived expectations, it is all but impossible. Users will develop a model of the technology they are using that works for them. Users rarely base their understanding of what is going on in the technology on what is actually happening.

If we go back to our question of which is the better way to the design of our mp3 interface it seems that working from what users goals are, what is currently available, and planning to meet existing needs is the better approach.
Design process

The user is central to current design methods. These usually include steps similar to the following:

1. Work from a realistic but imaginary user. By keeping this user in mind the designer can develop an empathy for all users to focus his or her thinking on how the interface will be used to meet user goals.
2. Determine typical tasks this user will do.
3. Determine the user model, i.e. how the user will expect to accomplish these activities. This is done by interviewing a range of users, or watching them in action. During this process users are encouraged to verbalise their actions (say what they are doing out loud), to gain an understanding of their goals.
4. Make a first draft of the design.
5. Refine the design to make it easier for the imaginary users.
6. When the device is ready prototype and test it with real users to determine if the program model meets the user model.

Good design

With rapid application development tools for programming it is easy to put together applications very quickly. Unfortunately if you as programmer do not keep basic design principles in mind you can create an interface that is at best unsettling, possibly ugly, and at worst distracting.

Good design is not something that comes easily to most people. While we can recognise a document or interface as being well presented, or striking, or appropriate, it is very difficult to see why it has had the effect is has had. If we want people to read the documents or use the interface we produce we must learn what makes a good design. This learning can take years but for now we will touch on the basics.

There are several basic design features that should be kept in mind as you go about developing your interface. These include placement, harmony, selection of typeface, and the use of colour.

Placement

Placement refers to how the different things in a document or page are positioned. The different things that make up the display are called its elements.

There are two basic rules for effective placement:

1. group related elements together so that they appear as a visual unit
2. at least one edge of an element should line up with the edge of another element.

The first rule tells us not to place things haphazardly. If elements belong together then group them together. Place a subheading close to a main heading, keep related fields together in logical order, and if graphics form a sequence then place them next to each other.

In contrast, if elements are not related then move them away from each other to create visual interest.
The second placement rule is that every element on a screen or page should have a visual connection to something else. This gives the document or page unity – by lining up one edge of a group of elements they gain a *visual cohesion*.

*Group related items and have the edge of each element line up with some other element*

Not everything need line up with everything else, but each element should have an edge lined up with another element, even if it is some distance away.

Haphazard placement is unsettling, and can confuse the user. Look at the following two layouts and decide which is more pleasing and would be easier to use:

*Grouping should be logical and aligned. Remember also in placing components and prompts that in our culture people read from left to right, and from top to bottom.*

*Size is also important in placement. Important elements on screen should be obvious. The larger an object the more important it is seen to be by the user. If you want to draw attention to something (e.g. a key prompt) make it stand out. At the same time if a set of objects are equally important (e.g. command buttons) making them the same size shows none is more significant than the others.*
The optical centre is where the user’s eye naturally falls when a screen or page is first seen. This is in the middle about two thirds of the way up. Important components that the designer wishes to draw to the user’s attention, such as a password login, should be placed at this point.

With web pages, while following the above guides to placement, allowance must also be made for the variety of screen sizes and resolutions. As a general rule place key details, button links or menu items towards the top left of screen. In this way users with smaller or lower resolution screens will still be able to view important elements without having to scroll to see them.

Finally do not be afraid of empty space. Be aware that there is no need to fill up the corners or place elements right up to the edges. White space is an important design consideration. The more white space the simpler and more “open” a page or screen appears.

Harmony

Just as with placement there are two aspects of the harmony, consistency and contrast.

Consistency means being constant and regular. To achieve consistency it is important to repeat some aspect of the design throughout the document or program. The repeated element can be the chosen fonts, graphics, layout, colour or any other repeated device. By presenting the same form of components the same way each time, and by repeating elements from one page or screen to the next the document, site or program will have a sense of unity.

At the same time as creating consistency, as designer you should be careful not to be too bland, there is such a thing as too much unity. Something that is all the same can be very boring.

Contrast is a way of achieving visual interest on a screen. To provide contrast, look for ways to exaggerate differences by using small/large, thick/thin, black/white, bold/plain, font or colour variations, and so on. In this way important items can be brought to the user’s attention while providing variety and creating interest on the page or screen.
The trap with contrast is not to over do it. A page or screen with too many contrasts is distracting and takes the user’s attention away from what you are trying to achieve.

Finally, in working toward harmony on screen or page, do not clutter the presentation with too many objects.

Choice of typeface
The next aspect of good design is looking at which typeface (font) or combination of typefaces to use. Depending on the mix chosen you can produce three different outcomes.

The first effect is through the use of a single typeface. By using a single family (plain, bold, italic, etc., and different sizes) a document can appear quiet, formal and harmonious. It can even be dull – but this might be the effect you are looking for.

This is the use of a single typeface called **Garamond**. While there is some variety in the size, shape and spacing of the letters they all belong to the same family and so blend well together.

To create a more appealing or interesting look combine two clearly distinct faces.

To create an effect find a type face that is a real **contrast** to the rest. Here there is just one word that is in a different font, but it stands out.

This is the second effect – contrasting typefaces. When you use this effect make sure the two faces are totally different. At the same time do not overuse the effect – it should be used to attract attention or provide contrast only, and should not distract the reader or user from the point you are trying to make.

It is also usual to use a contrasting typeface for headings and body text. In this book the san serif font Arial is used for headings, while Times New Roman is used for the body text.

The final effect is one that should be avoided. This is where two (or more) similar typefaces are used together. This can be disturbing to the reader because the typefaces conflict with one another.

In this extract three similar but different typefaces have been used. (Can you spot the three?) This can disturb the reader and make them wonder what is supposed to be happening, or if a mistake has been made.

Colour
Finally by choosing a dominant colour for a page or a screen you can influence the mood or atmosphere transmitted to the reader. The more a single colour dominates a layout, the more of an effect it has.

Colours have been found to have the following effects:

- Blue – peace and calm, tranquillity, contentment, tenderness, an effect of union or peace when joined with another colour
- Red – stimulating, action and excitement, impulse, appetite, desire, an effect of activity when joined with another colour
Green – assertion, tension, self-control and perseverance, pride, a forceful effect when joined with another colour
Yellow – aspiration, expansion, expectancy, originality, optimism and hopefulness, an expansive effect when joined with another colour
Violet – enchantment, fantasy, magic
Brown – security, comfort
Grey – neutral, static.

The use of colour in graphics, to highlight text, or as spot colour can be used to improve the appearance of a page or screen, and can help to focus a user’s attention. Again however be careful not to overuse colour. Too many different colours, or too strong a contrast can distract the user.

In addition to colour vivid graphics such as clipart, graphs or pictures can add interest to a presentation.

Finally care should be taken in using certain combinations of colours as this may disadvantage some users. For example between 5-10% of males cannot distinguish between red and green. Using text or images that feature colour combinations such as red-green or blue-yellow can make it difficult for users who are colour blind.

Activity 2.7 – By design

1. Why is it easier to change a program model than a user model of a piece of technology?
2. Designers often start with an imaginary user in mind. They will give this user a name, address, job, gender, interests, etc. How is having such a detailed user in mind an advantage in developing a UI?
3. a What are the key things to keep in mind when placing elements on a page or screen?
   b Why are these important?
4. a What is the difference between consistency and contrast when referring to design elements in a document or presentation?
   b What is meant by unity in a document or presentation? How do consistency and contrast affect unity?
5. What is “white space” and how can its presence or absence affect the appearance and feel of a document or screen?
6. Which principles of design do each of the following fulfil?
   a Less is better; less is more.
   b A good interface is transparent and maintains the flow so that it does not interrupt the user.
   c Design for the probable, provide for the possible.
   d Change the visual look, but not the functionality
7. It has been said that the choice of appropriate typeface (text font) for an advert can take as long as the selection of the accompanying graphics. How can the choice of typeface affect the impact, effect and feel of a presentation?

8. Suggest a predominant colour or colour combination that might be suitable for each of the following presentations:
   a. A dynamic web site aimed at a young market.
   b. An annual report for a charity foundation.
   c. An on-line game aimed at pre-teens.
   d. An accounting program interface.
   e. A social networking chat site.

9. If done well a design solution should be:
   - ethical – do no harm
   - purposeful – useful and useable
   - pragmatic – viable, feasible
   - elegant – efficient, artful, affective

   Pick one of these and, in a paragraph, explain why it is relevant to effective design.

SEI 2 – Physical consequences

The social effects of information systems are not limited to intangible influences, but can also include a more down-to-earth practical investigation into the physical consequences of using technology. In this our second look at SEI we will investigate biometrics, ergonomics, and occupational health and safety.

Biometrics

Human-computer interaction mostly involves studying technology so that we can determine ways to work with it more easily. However, in a sort of HCI in reverse, instead of us trying to come to grips with technology, we can also get it to interpret us. This area of study is called biometrics and it has wide reaching social consequences.

Biometrics literally means body measurement. Biometrics involves using technology to probe the features of a person to either identify them, or to verify they are who they say they are.

**Biometric validation**

In the tale of *Ali Baba and the Forty Thieves* it was possible to gain access to a cave by calling out “Open sesame!” The door to the hidden treasure would then swing open. Such a situation is no longer fanciful. It is now possible to come home and get your door to open, not with a key, but by you speaking to it. The voice recognition software does of course not open the door to anyone, just those it has been trained to accept. This is just one form of biometric validation. Nowadays face recognition, hand scanning, iris recognition, retinal scanning, and many other forms of biometric validation are in use.

The most widely and longest used form of biometric recording has been fingerprinting. The distinctive pattern of arches, loops and whorls on the pads of fingers has been a very accurate
way of identifying an individual, and has been used for crime fighting since the beginning of the twentieth century. Currently the FBI has over 230 million sets of fingerprints on file.

A very common problem with computer networks is password security. Users of sensitive systems are usually required to change their password regularly. These and other users also often have many different systems to log into. As a result of these factors, and also simple human forgetfulness, many users write their password down, or use the one password for multiple systems. This is poor security.

The solution some enterprises (and individuals) are taking is to install a fingerprint reader either on access doors or on a device attached to the computer keyboard. This cheap and accurate device makes a digital image of the user’s fingerprint that can then be compared with the print on file. Only authorised users will then be permitted to access the system, with others locked out. This not only improves security, it also provides a log of who has had access.

Fingerprint readers however are not particularly secure. They can be tricked with for example latex fingerprint overlays.

Other forms of biometric recording include:

- **face recognition** – an image of the face is digitised and then compared (eye distance, nose span, mouth width, etc) with images on file; a variety of techniques are used to determine if a match has been made including the use of neural networks; face recognition can work in airports to unobtrusively spot terrorists or criminals; it can also work by searching through just photographs; a variation uses a thermal map of the warm and cold parts of the face
- **iris recognition** – a photo of the iris (the front of the eye) is compared with file data; this method is very accurate, and has the advantage of being non-invasive because there is no close physical contact
- **retinal scanning** – analyses the layer of blood vessels at the back of the eye; the user must remove glasses, place their eye close to the device, and focus on a small light for 10-15 seconds; this is the most accurate form of biometrics known and is used in high security facilities; the eye of a dead person cannot be used to trick the device
- **hand/finger geometry** – the user places their hand (fingers) on a reader plate that compares the size and layout with file data; an alternative approach uses infra red to read the pattern of veins in the back of the hand
- **voice recognition** – the system recognises digitised speech in the form of a spoken password or normal spoken voice; it can be used over the phone or from a recording; difficulties may arise if the speaker has a cold or is out of breath
- **others** – there are a range of other biometrics used to identify people including DNA matching, signature recognition, typing patterns, walking gait, hand odour, ear shape, and so on.

Each of these forms has advantages and disadvantages. For example fingerprint readers are more readily accepted by the general public than retinal scanners. Fingerprint recognition is non-invasive, but many find the need to have a retinal reader close to their eye as intrusive and threatening.
Biometric recognition is becoming more widely used, and iris, face or voice recognition may soon be available at ATMs. The Australian Customs Service is investigating the addition of biometric data to passports.

**Potential abuses**

There are concerns from privacy groups at potential abuses of biometrics. Privacy groups are worried that too much information may be available to too many people. These concerns (whether real or not) have already led some organisations to reject biometric technology.

Another concern is with the electronic trail that is left by the person measured. Biometric records can effectively identify the movements of a person as they pass through an organisation or series of places that record biometric data. This information could then be used to build up a profile of movements of the person.

Biometrics are also being used increasingly in courts. Fingerprints have been used for many years, but DNA matching has been used to identify some criminals, and to free others who have been wrongly convicted.

A final issue in relation to biometrics is the ownership of the data. Through biometrics a person will have data about them stored on file. Who then owns this personal data? The user might think that it is private information, but the provider of the reader (bank, government, employer) might as easily conclude that since they control the data they can use it as they wish.

**Activity 2.8 – Do you measure up?**

1. **a** What does biometrics mean?
   **b** Give three examples of biometric measurement.
   **c** What is meant when a technique is described as being invasive?
   **d** Which of the technologies listed above would be described as being invasive?
   **e** Besides limiting access to buildings, suggest at least three other uses of biometrics.

2. **The two main uses of biometrics recognition are for identification (who is it?) and verification (is she who she says she is?)**
   **a** Explain the difference between an identification system and a verification system.
   **b** What is the difference between the sorts of data that would have to be recorded for each type of system?
   **c** Is using a face pattern to allow access to a secure institution identification or verification?
   **d** Is using fingerprints to link a criminal to a crime scene identification or verification?

3. **The use of biometric recording raises several privacy issues. Comment on each of the following. As you do explain what effect each has on the individual and then discuss the implications of the invasion of privacy:**
a Using the now ubiquitous security cameras, an individual who has done nothing wrong can automatically be identified and then tracked without their knowledge.

b Once biometric data has been captured the individual has little control of how this data can be distributed or used.

c Certain religious or ethnic groups have significant reservations with the recording of an individual’s features. Some do not permit the taking of photographs of faces, others do not allow fingerprinting. Others are especially disturbed at invasive forms of monitoring such as blood or DNA scanning, or even retinal imaging.

4. Describe how you think your feelings would be if you were aware that your movements were constantly being monitored by biometric technology.

5. During times of concern over the spread of epidemics such as SARS or Bird Flu automatic screening devices are put in place at airports to monitor incoming passengers.
   a What forms do these automatic screening devices take?
   b Why are these biometric devices used rather than using people?

6. Unfortunately biometrics such as DNA matching or retinal scans are so accurate that they have an aura of infallibility. Despite this biometrics can be fooled.
   a How might someone persuade a fingerprint reader they were an authorised user?
   b Suggest a way to fool a voice recognition device.
   c Innocent people have been convicted even with DNA evidence. How might this have happened?

Ergonomics

Ergonomics is the study of the relationship between a person and their workplace. Its aim is to provide a safer, more comfortable and productive environment. Ergonomics is concerned with adjusting the environment to the worker, rather than the older idea of making a worker fit into a given workplace.

The principle areas of consideration in relation to ergonomics and HCI in the workplace are posture and environment.

Posture

Most people in an IT environment work at a keyboard, usually for long periods of time. To avoid circulatory problems, muscle fatigue, neck and shoulder strain and long term spinal problems, sitting at a correctly designed work station is important.

The chair should have height adjustment so that feet can rest comfortably on the floor and the thighs are supported without being under pressure. If necessary foot rests should be used. A backrest will provide lumbar support. The chair should be stable, sturdy, preferably swivel, and be on castors so it can move freely.

The keyboard should also be at an appropriate height and distance so that the arms can be held horizontal and over it. There should be wrist rests.

The screen should be placed so that there is a slight down angle from eye level at a distance of about 40-60cm. A document holder next to the screen also helps.

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Ergonomic environments are well planned

The user should establish a routine of regular exercise and rest periods to ease stresses and strains caused by working in the same position for extended sessions.

**Environment**
Workplace ergonomics include:

- **lighting** – is there sufficient light to complete tasks without eye strain? is there glare on screens? is lighting soft? do screens flicker? is writing on screens and printouts legible?
- **noise** – is the workplace free of excessive noise (printers, other workers)? is there effective sound absorption (carpets, padded section dividers, etc.)? does outside noise intrude?
- **climate** – is the temperature comfortable? is humidity satisfactory? is their adequate ventilation (fresh air)?
- **space** – is the individual workplace crowded or cluttered? does each worker have enough room to do their job? are walkways and doorways wide enough so that people can move freely and without unnecessary contact?
- **safety** – are there things people can trip over (carpet, cables, bags)? are there objects that heads can bang against? are there sharp corners that can be knocked against?
- **ambience** – is this a pleasant place to work? is there a pleasing colour scheme? are there plants and pictures to break the monotony? can workers focus their eyes on objects over 6-10m away? are cables and unnecessary items out of sight?

In addition to posture and environment the materials an IT worker uses can also be improved by effective ergonomics and the HCI.

The layout of the work station should be such that common items (printer, keyboard, mouse, etc.) are within easy reach. As mentioned above the chair, desk, keyboard and screen should be comfortable to use without strain. An LCD screen and a quiet printer are preferable. Software should be easy to use, fault tolerant and have effective user assistance.
**Rest and Exercise**

Keyboard operators (and students) should get into the habit of including regular rest breaks and exercises into their work routine.

It is recommended to take a 30-60 second break for every 10 minutes of keyboard activity. This can involve proof reading printouts, doing hand or neck exercises, or getting up and walking across the room and back. Smaller rest breaks of a few seconds can be taken by removing the arms from the keying position, resting the wrists, or focussing the eyes on a distant object. In addition hand and neck exercises should be carried out every 30 minutes or so.

Without adequate rest and exercise the keyboard operator may suffer from what was once called repetitive strain injury (RSI) although it is now more correctly referred to as occupational overuse syndrome (OOS).

OOS may result from continued repetitive movement, poor posture or forceful movements. Stress may be a contributing factor. Soreness in the wrist (tenosynovitis) the elbow (epicondylitis) or muscle strain in the neck, shoulder, upper or lower arm are all signs of OOS. They are characterised by pain or tenderness in the affected area. There may be swelling, numbness or tingling. OOS injuries are slow to heal.

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**Activity 2.9 – Safety, health and comfort**

1. a What is meant by the term ergonomics?
   b How does ergonomics relate to HCI?
   c Why is the study of ergonomics important in the workplace?

2. Work with a partner to determine the ergonomics of the work space in your computer room. Refer to the notes above for details to check.
   a One person is to sit at a computer. The other is to record the positive and negative aspects of the computer user’s posture. Make a comment on the layout of the materials this person must use, and how much space they have.
   b Analyse the environment of the computer room. What are the good and what are the bad ergonomics of the room? (Hint: use the six dot points on pages 59-60 to focus your investigation.)

3. a What is OOS?
   b Keyboard operators who work long shifts entering data often complain of tender, swollen wrists. What is this described as and what causes it? How can it be treated?
   c At one time RSI received a great deal of negative publicity. Sufferers were accused of malingering (pretending to be unwell) and of falsely seeking workers compensation. RSI became known as an Australian phenomenon and was referred to as “kangaroo paw”. Why do you think there was this misunderstanding of the complaint? In what ways has the change of name to OOS helped?

4. Design and draw an ergonomic layout for a student computer workstation as seen from above. This can be at home or in a classroom. The most frequently used items should be within easy reach, and available space should be effectively and efficiently used.
Occupational health and safety

You may have heard someone pointing out a situation and saying “...that’s an accident waiting to happen”.

Every day people are injured at work or are placed in situations in which their health or well-being is threatened, yet with care and forethought many dangerous situations can be avoided. Workplace health and safety laws have been enacted to provide a framework for the safe management of workplaces, including schools. It is important all users of information technology are familiar with occupational health and safety (OHS) practices in the workplace.

The OHS guidelines and regulations in place today are the result of the efforts of employees and their unions over many years to establish a safer workplace.

The Queensland Workplace Health and Safety Act (1989) is designed to promote the health and safety of people performing work, and to protect members of the public from dangers.

Under the Queensland Act employers are required to:

- provide and maintain safe equipment and ways of working
- ensure the safe use, handling, storage and transportation of equipment or substances
- provide appropriate instruction, training and supervision
- provide personal protective equipment
- ensure the safety of the general public.

Employees also have responsibilities and must:

- not wilfully endanger themselves or others through their actions in the workplace
- follow health and safety instructions
- use protective clothing and/or equipment provided.

Dangers in the work environment can be divided into the following categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Danger</th>
</tr>
</thead>
<tbody>
<tr>
<td>environmental</td>
<td>noise, fumes, light and heat, biological, communicable illness</td>
</tr>
<tr>
<td>design</td>
<td>poorly designed equipment, inferior work place layout</td>
</tr>
<tr>
<td>procedural</td>
<td>inadequate ways of doing things, lack of appropriate procedures</td>
</tr>
<tr>
<td>human behaviour</td>
<td>lack of training, failing to follow procedures, foolish activities</td>
</tr>
</tbody>
</table>

If you become concerned about a health and safety issue in your work environment it is your responsibility to report it to someone in authority. In a classroom it would be your teacher, in the workplace, your supervisor.

If the issue is not dealt with or resolved you must inform the OHS committee or safety officer. Failure to report a dangerous situation or practice could lead to injury.
Activity 2.10 – Safety in the workplace

1. a Find the name of the OHS representative at your school.
   b What responsibilities does this person have?

2. a What does legally binding mean?
   b What is the name of the OHS statute in Queensland?
   c Identify three responsibilities of employers under this Act.
   d Describe an example of one way an employer might not meet the provisions of the Act.
   e Identify two responsibilities of employees under this Act.
   f Describe an example of one way an employee might not meet the provisions of the Act.

3. Identify the hazard in each of the following situations as environmental (E), design (D), procedural (P) or human behaviour (H). Some may be a combination of these:
   a a ringing in the ears after sitting next to a printer all day
   b back ache after carrying two boxes of printer paper at once
   c getting headaches after the carpets in the library have been cleaned
   d electric shock from a frayed wire
   e tripping over a bag left next to a desk
   f tiredness and frustration after being given too much to do in too short a time
   g a fire in a pile of recycling paper
   h headache from staring at a screen reflecting overhead lights
   i knocking a shin against a protruding shelf causing it to bleed
   j catching a cold from a fellow student.

4. a Identify as many potential hazards as you can in the room you are in at the moment.
   b If any of these potential hazards is a probable hazard who should you notify? (And will you?)

5. a Why should you not use electrical devices (e.g. light switches) with wet hands?
   b What is the first thing that should be done if water is spilt near an electrical outlet?

6. Outline the correct procedure for lifting a heavy object from the floor.

7. a What is the fire signal at your school?
   b What are the three steps you must follow if you detect a fire? Why must they be done in this order?
   c Why is it necessary to have at least two ways out of any room?
   d If caught in a burning building you are advised to feel a closed door with the back of your hand before opening it. Explain why this is a good precaution.
c Draw up a plan of the building you are in (or if possible a nearby two storey building). On the plan indicate with arrows an evacuation plan, i.e. the ways people are to leave the building to avoid congestion. Include an assembly point away from the building.

8. a Where are the nearest first aid facilities to where you are sitting now?
   b How is the nearest trained first aid person contacted?

9. Your teacher will provide you with an *Incident Report Form* obtained from the OHS officer. Complete it based on the following incident.

   Mike and Jerry wanted to put a poster up on the wall above Jerry's desk just after lunch last week. Mike had climbed onto the desk while Jerry was passing him the poster and BluTac. As he stepped across to fix the left hand side Mike’s foot slipped off the edge of the desk and he fell to the floor and dislocated his arm at the shoulder. Though he was in great pain he was conscious. Jerry got him comfortable and phoned for the first aid officer. Sr Jane arrived within three minutes, put Mike’s arm in a sling and called for an ambulance. He was taken to outpatient’s at the local hospital where the intern “popped” the arm back in. Mike returned none the worse after two days off school.

*Next we are going to see how computers can be used to solve problems*