Access-Ability

Making technology more useable by people with disabilities

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Guidelines for accessible technology

Introduction

This publication provides an overview of guidelines that are now available on the Internet to help designers, engineers and technicians solve the problems of making the technology in our everyday lives accessible and easier to use by elderly people and people with disabilities.

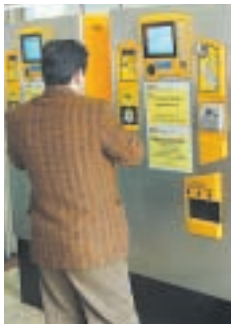
It is the experience of many who are neither elderly or disabled, that the technology in our everyday lives is both complex and difficult to deal with. From video recorder and television controls to mobile phones, ticket selling machines, screen interfaces and e-mail systems. Almost nothing is simple. Most devices are complicated and off-putting.

People with disabilities, such as low vision or poor manual dexterity, have long had to deal with devices that have not been designed with their needs in mind. There is now growing concern that the lack of design foresight is creating greater social exclusion.

Governments, such as those in the UK, are committed to greater inclusion for persons with disabilities. New systems for on-line voting and the delivery of screen-based services and information are under way. In public places we have to interact with information screens, automatic gates and ticket machines. In our homes devices use remote controls, buttons and screens.

Inclusive design

Inclusive design is "The design of mainstream products and services that are accessible to, and usable by, as many people as reasonably possible, in a wide variety of situations and to the greatest extent possible without the need for special adaptation or specialised design".



The number of people with special needs is larger than the number of people with disabilities since it includes children (about 20% of the UK population), older people (about 15%) and people who are left-handed (about 10%). Another significant group is those people who have limited knowledge of the English language, this includes some immigrants as well as foreign visitors. In addition systems for use by the general public should take into account differences in culture, particularly among ethnic minorities, which may render some designs unacceptable.

The increasing need to adopt an inclusive design approach is because of:

- The increasing number of older people
- Changing consumer expectations, particularly with regard to retirement
- New procurement policies (particularly from government departments)
- New legislation (such as the Disability Discrimination Act).

Demographics

The user groups described here have been defined in terms of their functional ability, with specific emphasis on use of information and communication technology systems.

In the elderly population in particular, there may be a tendency towards hearing, vision and mobility impairments arising in parallel. Therefore, while the numbers are 'best estimates' for single groups of users, they should not be aggregated. The group sizes have been estimated conservatively and very much larger numbers would be obtained if lower levels of impairment were included. For example, over half of the population needs some form of optical correction, and about one sixth has a clinically significant level of hearing loss.

The lower levels of impairment will not normally lead to difficulties in using information and communication systems but can cause problems in adverse circumstances.

Visually impaired

The eye conditions which most commonly cause low vision are:

- Macular degeneration
- Glaucoma
- Diabetic retinopathy
- Cataract
- Retinitis pigmentosa

- **67% of visually impaired people have another permanent illness or disability.**
- **35% of visually impaired people experience some difficulty in hearing normal speech (about 50% of those over 75).**
- **56% of visually impaired children have at least one other impairment.**
- **Over half of visually impaired people in the UK live alone.**

Hearing impaired

Hearing loss is not simply a matter of reduced sensitivity that can be overcome by increasing signal loudness. Hearing loss is usually dependant on the frequency (pitch) of the sound. People with hearing loss have the same pain and discomfort thresholds for sound as hearing people, so that when sound is amplified so that it can be heard it is quite easy for the sound to reach the discomfort or pain thresholds.

It is estimated that up to 9 million people in the UK have a hearing loss (mild hearing loss to profound deafness).

Physically impaired

Physical problems can make holding a handset difficult and make keypad or touch-screen operation slow and inaccurate. These tasks may also be painful. Being in a wheelchair or needing a walking stick can make access to machines difficult. Physical difficulties include:

- weak grip
- arthritis
- cerebral palsy
- spinal cord injury
- head injury
- stroke
- loss of limbs or fingers
- Parkinson's disease
- multiple sclerosis
- muscular dystrophy

Macular degeneration

This is how a person with normal vision would see a telephone. The other pictures demonstrate how someone with various eye conditions might see their telephone.

Cognitively impaired

The type of cognitive impairment can vary widely, from severe retardation to inability to remember, to the absence or impairment of specific cognitive functions (most particularly, language). Therefore, the types of functional limitations which can result also vary widely and include:

- Cognitive impairment
- Dyslexia
- Learning impairment
- Language impairment
- Dementia
- Seizure disorders

- **2.5 million people in the UK have a speech or language difficulty.**
- **5% of children enter school with difficulties in speech and language.**
- **30% of stroke sufferers have a persisting speech and language disorder.**

Older people

Older people tend to be slower to learn new skills, have difficulty in memorising and reacting quickly to instructions. Also many elderly people prefer human assistance to using self-service terminals; however, this is not insuperable with suitable user interfaces and appropriate training. Many elderly people use the telephone or video cassette recorder even though they may not be familiar with all of its facilities.

For elderly people it is important to remember that hearing, vision and mobility impairments combine to make information technology more difficult to use.

Cataracts

Diabetic retinopathy

Tunnel vision

Estimated percentage of population in Europe with problems using information and communication technology:

Wheelchair user:	0.4%
Cannot walk without aid:	5%
Cannot use fingers:	0.1%
Cannot use one arm:	0.1%
Reduced strength:	2.8%
Reduced coordination:	1.4%
Speech impaired:	0.25%
Language impaired:	0.6%
Dyslexic:	1%
Intellectually impaired:	3%
Deaf:	0.1%
Hard of hearing:	6%
Blind:	0.1%
Low vision:	1.5%

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Transport

Transport companies are designing new and different systems to sell tickets, control doors and gates, provide information, announce destinations and make transport more easy to use. These systems require that we interact with screens and keypads, insert coins, banknotes and payment cards, activate gates with tickets or smart cards, press buttons, read displays, listen to announcements and follow signs.

The best of these systems allow people with good eyesight and quick movements to pass quickly on trains and buses. For people who have low vision, use wheelchairs, are deaf or have poor manual dexterity, these interfaces and controls can make travelling a very difficult process.

A typical journey is likely to involve:

- Deciding how to get there
- Getting information from a timetable
- Getting to embarkation point
- Buying a ticket
- Knowing which bus, train or tram to board
- Getting on and finding a seat
- Finding and operating gates and doors
- Knowing where you are
- Knowing when to disembark

Planning a journey

Many journeys involve using more than one mode of transport. However, obtaining reliable information about the various options and relative costs is not easy, particularly if you have a visual impairment or limited mobility.

Timetables can be confusing even if you can read the numbers and visually track across columns. Many elderly people find timetables so daunting that they are put off using public transport other than on routes with which they are familiar.

Ticket machines

Buying tickets from machines is a complex activity. The large number of variants in destination, ticket types and costs means that a user has to select options by touching a screen or pressing a range of keys or buttons. Money or payment cards also need to be inserted. It is possible to design machines that have large clear screens that are easy to read, and to design a sequence of actions that are easy to follow.

If ticket machines are not easy to use by disabled or elderly passengers, then appropriate alternative methods for ticket purchase should be available.

Screens

Screens that are clear and bright, that use legible typefaces and that are designed to display information in a clear logical sequence, greatly help most users. Touchscreens can eliminate the need to press complex keypads. Screens should be positioned to reduce reflective glare from sunlight or illumination.

Gateways and barriers

Many gateways and barriers activate when a ticket is inserted in a slot or when a contactless smart card is used. Gateways and barriers need to be clearly signed so that people with low vision can see which way to enter a gate. Signs, instructions and ticket slots must be clearly visible, illuminated well and designed to help people with poor manual dexterity.

Smart cards

Smart cards are able to carry information that can make machines more 'user friendly' than they have ever been before. For disabled and elderly people, a smart card can carry information that specifically relates to the individual and that can tell a device to:

- allow the user more time
- simplify the choices, such as issuing a pre-set ticket type
- display larger characters for people with low vision
- provide audible output

Navigation systems

Navigation systems, such as those used in cars, have the potential to assist blind pedestrians, and could be linked to automated information systems accessible by telephone with voice commands.

Contactless smart cards

A contactless card, working at a distance of up to 10 cm, will help those who have problems placing a card in a slot. This is of particular importance to wheelchair users, those with Parkinson's disease or arthritis, and people with a visual disability.

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Financial transactions

Increasingly the financial transactions we make in our everyday lives involve the use of payment cards, keypads and screens. We interact with screens and keypads on cash machines; we are asked to check payment amounts on visual displays and enter PIN numbers on keypads.

These type of transactions take place in shops, restaurants and transport systems every day. Smart cards and Chip and PIN cards are nearly always required for these financial systems.

People with low vision, poor manual dexterity, cognitive impairments or who are in wheelchairs can find these devices and machines very difficult unless the terminals and machines are easy to reach, easy to see and easy to operate.

These pages show some examples of the guidelines that cover financial transactions - they include:

- Locating and accessing terminals
- Card systems
- Chip and PIN systems
- Screens and interaction
- Labels
- Operating instructions
- Inserting cards, coins and banknotes
- Keypads
- The arrangement of keys
- Distinguishing function keys
- Audible and tactile feedback
- Screen position
- Typefaces and legibility
- Parallax problems
- Touchscreens
- Retrieving money, cards and receipts

Chip and PIN cards

The Chip and PIN system is being promoted as the main way to pay using credit and debit cards. Most shops, restaurants, petrol stations and other outlets will have new tills with 'PIN pads'. With a Chip and PIN card, customers will be asked to enter their 4 digit personal identification number (PIN) at the point of sale instead of signing a paper receipt.

For people with hand tremors or a visual impairment, inputting a PIN may be much easier than signing a poorly printed slip of paper.

The process for using a Chip and PIN card will be:

1 The shop assistant will input the amount to be paid.

2 The customer will hand their card to the assistant, or insert it themselves in the terminal.

3 The customer will then check the amount on a visual display.

4 The customer will input their PIN on a numeric keypad. This keypad may be on a flexible lead of sufficient length that it can be operated from a wheelchair.

5 The terminal will print a receipt so that the customer has a record of the transaction.

In a restaurant, the system will be the same except that the waiter or waitress will have a portable terminal which he or she will hand to the customer for the PIN to be entered.

Screens and interaction

On most terminals the visual instructions on the screen are the main guide for the user. There are a large number of factors that determine whether reading the screen will be difficult or easy for disabled or elderly persons. The size of type, brightness and contrast are very important in helping read text on a screen display. For hand-held Chip and PIN terminals the display must be large enough for a person with low vision to see text and numerals. For a cash or ticket machine, the screen must be positioned so that reflection and glare do not make it difficult read the screen.

Electronic purses

Although electronic purses could be used as a replacement for cash, it appears likely that in the future the main applications will be in special areas. A typical scenario for using an electronic purse might start with a person loading and checking their card with a telephone linked device at home, driving to a station car park, using the card to pay for entrance to the car park and paying for a train ticket. The electronic purse can be topped up at a bank cash machine.

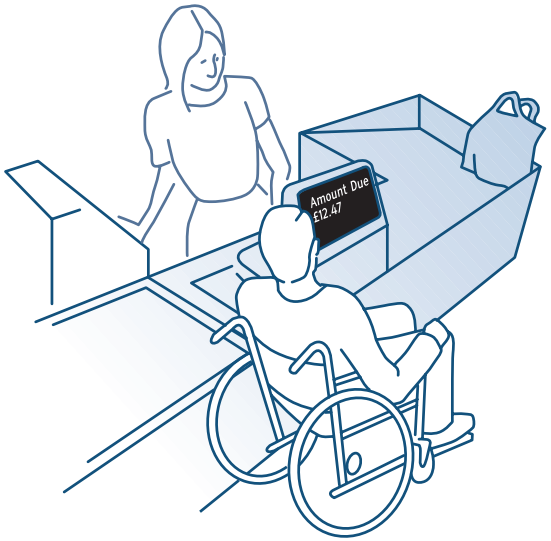
Mobile phones can also be used as a form of electronic purse. In Scandinavia a person can stop at a vending machine and buy a bar of chocolate using their mobile phone. The cost is charged to their telephone bill.

For local government, the use of electronic payments can reduce costs. For example if car parking were paid with electronic purses, the cost of a person emptying cash from machines could be saved. Where subsidised costs are used, for school meals or local transport, an electronic purse can store specific information relating to different payment rates. The facility to have an audit trail for payments can also be of great advantage.

All of the potential applications of electronic payments create opportunities for improved management and cost savings. However, for these systems to be used by everyone, thought must be given to how people with disabilities would use the keypads and screens of devices that are designed to be small and easy to carry.

Banknotes and coins

Many machines take banknotes and coins. People with low vision can have difficulty identifying a banknote and inserting it in a terminal. Machines should be designed to accept banknotes in any orientation. The machine should also clearly display the status of the transaction, and inform the user why the banknote has not been accepted.



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Public access terminals

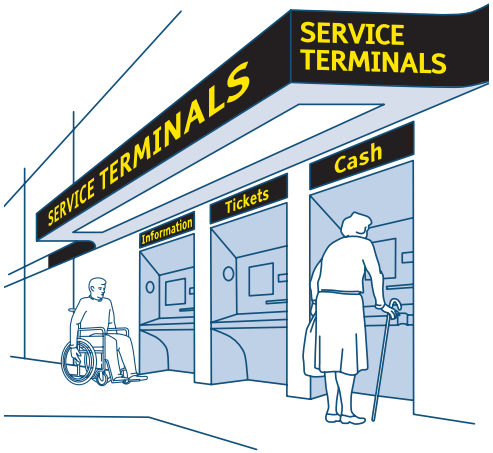
An ever growing number of terminals in public places demand that we interact with screens and buttons to buy tickets, draw money, use services or get information. The way these machines are designed and how they operate can be very different. Locating and using them – particularly for people who are blind, have low vision or other disabilities – can be very difficult.

To make significant progress in accessibility and ease of use, public terminal designers, manufacturers and service providers must adopt an inclusive design policy and better design standards.

In some countries legislation now requires service providers to make public access terminals accessible to people with disabilities. The high cost of retrofits means that it will be wise to consider these needs when planning new systems or services.

Some people may only use a public terminal occasionally and generally with little or no training. To make public terminals easy to use it is important that they are designed with an easily understood system of operation, clear instructions and a response system that lets the user know what is happening. What is 'logical' to the average user may be different from what is 'logical' to the designer of a terminal. It is essential to test any new user interface with a cross-section of potential users, including disabled and elderly people.

There are some well designed terminals that are easy to use. For example, some terminals will recognise a card when it is entered and offer the user the option to carry out the same task as last time, such as purchase the same train ticket.



For many disabled and elderly users, the most important aspect is consistency in the user interface; this is particularly important for visually, intellectually and cognitively impaired users. A prime example of inconsistency is the lack of a single standard relating to the layout of numeric keypads.

Access

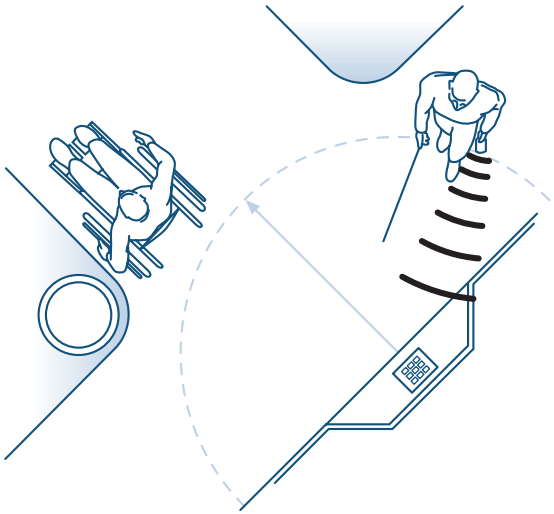
There are many things that can be designed around a terminal to make it more accessible to disabled and elderly users. For example, a space beneath the facia of the terminal will allow for the footrest of a wheelchair. A notch adjacent to the facia would be useful for those needing to prop their walking sticks while using the terminal.

Location and instructions

For low vision users, signs showing where a terminal is should be large and high contrast. Instruction labels should be placed where they can be easily read. If labels are positioned near the keyboard, it is important that the labels are not scuffed or worn away. If this is likely then the labels should be replaced periodically.

Audible location

If a blind person is not familiar with the environment, it can be difficult to find a terminal. One possibility is to use a contactless smart card, carried by the blind person, to trigger an audible signal from the terminal at a distance of a few metres.



Queuing

Where queuing is likely, consideration should be given to some non-obstructive method of queue control such as variation in colour of flooring or pavement. The system should maintain privacy and security for the user.

Floor surface

The floor surface should be level in the direction parallel to the facia of the terminal. The gradient of any crossfall should not exceed 1 in 20. There should be a clear area of 1.5 metres radius directly in front of the terminal, which should not be obstructed by litter bins or other street furniture.

Lighting

It is recommended that a background illumination of at least 50 lux be provided at floor level. The illumination on the interactive areas of the terminal should be at least 200 lux. The lighting should not cause any direct glare to the eyes of the users, or reflections from the screen.

Screen position

Sunlight can degrade the viewability of the display for all users. The screen should be shielded from direct or reflected sunlight or other bright light sources. The display should be viewable from the eye level of a person sitting in a wheelchair. People with low vision should not be prevented from getting their faces close to the screen.

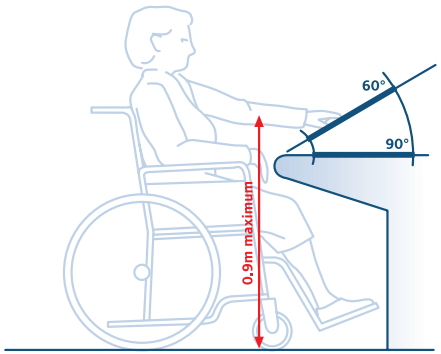
People who wear bifocals find it difficult to read the screen of most public access terminals, since the screen may not be at a suitable distance for the near or far segments of their spectacles.

Parallax problems

The conflicting requirements of tall pedestrian users and short wheelchair users can lead to a significant group of users having parallax problems when lining up the function keys with the displayed option. Lines on the user-interface leading from the key to the surface of the display can alleviate this problem.

The guidelines that cover public access terminals include:

- Location signs
- Queuing systems
- Lighting
- Floor surface
- Clear area
- Audible location
- Card systems
- Swipe card readers
- Embossing on cards
- Contactless smart cards
- Card orientation
- Labels
- Numbered instructions
- Braille instructions
- Legibility
- Card entry
- Screens and interaction
- Screen position
- Parallax problems
- Audible instructions
- Speech output
- Video links



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Telecommunications

The conventional fixed-line telephone has provided enormous benefits for many people with disabilities and older people. However the evolution from being solely an audio system to one which also carries data has introduced new possibilities as well as new problems.

Additional services, such as e-mail, mobile and video phones require the use of a screen to display text and often graphics. These screen phones pose obvious problems for people with a visual or cognitive impairment, but there are methods for alleviating these problems.

The speed of telecommunications development poses new problems on how to incorporate inclusive design in the development process.

These pages show some examples of the guidelines that cover telecommunications – they include:

- Mobile phones
- Screens and interaction
- Video phones
- Bluetooth and wireless systems
- Keypads
- The arrangement of keys
- Distinguishing function keys
- Audible and tactile feedback
- Typefaces and legibility

Mobile phones

Mobile communications are spreading, not only in quantity but also in diversity. More and more applications are evolving. A typical example is the payment of London congestion charges using text messaging or the use of mobile phones to pay for items from vending machines where the charge comes through on the telephone bill.

The decreasing size of handsets has brought advantages to many users but at the expense of small keypads, limited sidetone, and small visual displays. To provide accessible services may require increased collaboration between network providers and terminal developers; legislation in various countries may provide the stimulus for commercial organisations to seriously consider the needs of disabled users.

Keypads

Enlarged keys enable persons with poor dexterity to press the correct key; the spacing between the keys is as important as the size of the keys themselves. A concave shape to the keys will also help fingers to stay in place. Guarded or recessed keys can help a person who has difficulty in making precise finger movements. A dial-out buffer memory enables users who are slow in dialling to avoid being timed out.

The optimum spacing of keys on a mobile phone handset will depend on whether the user uses a thumb or finger to press the keys. Teenagers tend to use their thumbs, but many elderly people prefer to use a finger; this has implications for the optimum spacing between keys.

Visual ringing signal

Visual ringing signal is essential for people who are deaf. Visual signals incorporated in the terminal are often not easily seen and are mainly of use as a reminder of line status. An interface should be provided so that external lights or a vibrating pager can be triggered by the phone.

Screens

The screens on telephones tend to be small. A large character display is essential for many people with a visual impairment. The visual display should also be high contrast. This is particularly important now that telephones are used to access more services such as timetables.

Wireless systems

Bluetooth is one example of a short-range wireless technology that can link appliances and devices together, so that control and communication can be managed remotely. It offers a number of very interesting and important applications for people with disabilities. Small devices that have tiny knobs – mobile phones, hearing aids, pocket calculators etc. – could be controlled from a separate keypad, appropriate to the user's needs, connected via a Bluetooth link. This is of great significance because the mobile phone itself could replace the remote control for televisions and video recorders. It can provide an interactive channel (for services such as tele-shopping) while connecting to the television via Bluetooth.

Video telephony

Video phones have been slow to make significant market penetration. This is attributable to the low bandwidth available to most domestic consumers. For deaf users, a video phone could transmit sign language with a modest picture quality, but greater bandwidth is needed for lip reading.

Relay systems

Relay systems use an operator to help textphone users to communicate with people using ordinary voice phones. Where a call is being made between people using an ordinary voice phone and a textphone, an operator will automatically join the call and translate what is being said.

Interactive voice response

Interactive voice response (IVR) systems can give particular problems for deaf users and those with a cognitive impairment. Using a one-piece phone, where the keypad is integral with the headset, makes it difficult for the user to simultaneously listen and press keys. Therefore, adequate time needs to be given for the user to respond.

Recommendations for IVR are:

- Allow for users who need extra time to respond to prompts
- Provide a means of access to a human operator
- Provide a recovery route from error
- Provide different audio feedback for valid and invalid key presses
- Provide a consistent and predictable user interface
- Use consistent terminology
- Keep user IDs to no more than 8 digits
- Do not require that the same information is entered more than once
- Provide users with the facility to repeat the audio output
- Provide context-sensitive help

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Computing

Computing is an area which has changed dramatically in the last twenty years. No longer are the main users people with knowledge of programming. However there are indications that too many systems are still designed for users with a background in computing; for instance, with some computers one has to click on 'start' when one wants to turn off the computer.

Computer design continues to produce devices that are innovative, more portable and ever more useful. However, on many computers the user interface has evolved at a slower rate. Most personal computers have a visual display, an alphanumeric keyboard and a pointing device such as a mouse. Many of the new smaller computers such as PDAs (Personal Digital Assistants) require the use of a stylus pointer rather than a physical keyboard, which requires precise eye-hand coordination.

Computer Hardware

The reduction in the size of computers, the addition of innovative plug-in devices, the need to interact with precision all require that we have good manual dexterity, good eyesight and a good understanding of how devices connect and how to use controls. Anyone who does not have these capabilities cannot easily use these devices.

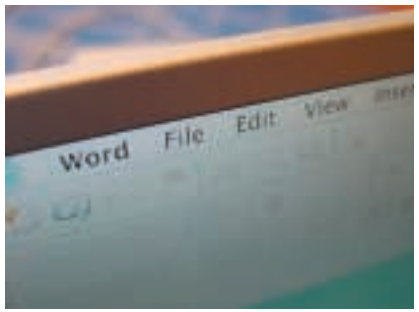
For many people connecting peripherals can be problematic. Physically impaired users often have difficulty in using input devices or in handling storage media. People with a severe physical impairment would find it useful if a means of connecting an alternative keyboard were available or if hardware sockets, such as USB, were mounted on the front of computers.

Some work has been done to include facilities to help people with disabilities. Wireless systems are making it easier to connect devices but, given how helpful computers can be in our everyday lives, it is very important that the things that would help people with disabilities are carefully considered and designed into new generations of hardware and software.

Interacting with computers

Visually impaired users often have problems with reading the display as well as using input devices such as a mouse. The option to use keyboard input instead of a pointing device is essential to blind users. Synthetic speech output or braille displays can output text, but graphics are problematic. Also it is difficult to interpret spatial relationships, such as layout, from just textual output.

Since audio output is limited in most computer systems, the problems for hearing impaired users are few; however it is helpful if audible warning signals can be displayed visually. The increasing use of multi-media output means that more consideration should be given to the needs of hearing impaired users.



Computer Software

Computer software has become much more sophisticated in the last decade. The norm is now to use a graphical user interface, such as Windows, which can be accessible but is not easy to use non-visually (e.g. with synthetic speech output). However most operating systems now incorporate accessibility features, but many older users are unaware that these exist.

Particular problems are caused by software which bypasses the standard protocols in the operating system; this can mean that assistive devices will not operate correctly.

Cognitively impaired users can sometimes use specific applications with little difficulty once the application is launched and configured for their needs. However they often find error messages incomprehensible and then get confused as to how they can recover from the situation. Such problems can also put off older users who may be less experienced in using computer systems.

Internet

E-mail, since it is text-based, has been very useful for many blind people since it is relatively easy to learn and to use.

The world wide web offers exciting possibilities for accessing large quantities of information but there are problems. Firstly the blind user needs a suitable browser. A problem is that many web sites use graphics such that they are not meaningful when accessed by a text-based browser (e.g. with speech or Braille output). Guidelines have been produced for how to design accessible web sites, but these guidelines are widely ignored by commercial organisations.

The tools used by professional web site designers now allow web sites to be built that can deliver 'rich media'. It is thus possible to deliver 'voice labels' that provide information in sound form in such a way that a person with low vision can interact using a keyboard and receive audible responses.

Web sites which require the user to fill in a form need careful design if they are to be fully accessible as well as being easy to use with non-visual output.

Checklist

A comprehensive checklist is available in the guidelines covering important points for designers of hardware and software systems. They include questions such as:

- Are controls and latches (on/off) reachable and operable with one hand and minimal dexterity?
- Can voice recognition be used to control the operating system?
- Does the operating system provide services for the applications to be accessible?
- Can the accessibility features be easily turned on and off?
- Does the operating system provide user preference profiles?
- Are all the operating system functions (including navigation) accessible by keyboard?
- Can insertion and removal of frequently accessed media be done using minimal reach and manual dexterity?
- Can the screen image be enlarged?
- If the product delivers speech output, are there mechanisms for private listening and interrupting the output?

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Television

Television is today's main medium for information and entertainment. Digital television is now replacing the old style analogue television. It is becoming highly interactive and requires all users to be able to use remote controls with an on-screen display.

New television services are likely to become more interactive, delivering important information and services, linking with e-mail and the Internet, allowing us to download, respond and carry out such tasks as e-voting and e-learning.

If everyone is to be allowed access to this medium, the controls and operating systems must be designed to include the needs of people with disabilities.

Interactive television

As digital television evolves the new levels of interactivity will include such things as:

- TV guides
- Social contact, e.g. e-mail
- Interactive/online games
- Enhanced programmes, e.g. voting on outcomes/issues
- Video on demand
- Shopping
- Live interactive sport, e.g. altering viewing options
- Talking books/radio
- Current affairs, e.g. news, financial information
- Interactive non-broadcast content, e.g. healthcare advice
- Web sites/TV portals
- Interactive advertising
- Courses/learning
- Search for jobs/holidays, etc.

The current systems for interactive digital television appear to have been based on the conceptual models of keyboard-based personal computer systems. These seem to have evolved with the original TV remote controls to give a system that is becoming increasingly difficult to understand or use. Most people need to use different handsets to control the different television devices; digital receivers, video and CD recorders, and the television itself.

People with poor manual dexterity, visual or cognitive impairments can find accessing television very difficult. The wide variety of users have different skills, goals and attitudes to the interaction required.

Many older people are reluctant to use personal computers but would be prepared to use interactive television to obtain information (e.g. about local council services). However, if their initial experience is poor, they may be reluctant to try using interactive television in the future.

If interactive television is to continue to develop as one of our main information systems, it is very important for designers to realise that interactive television is not the same as a personal computer and therefore its design must be treated differently. If the functions and controls are poorly designed, they will be rendered inaccessible and not easily usable by many of the population who could greatly benefit from them.

Remote control devices

In comparison to computer screens, most people view television a long distance from their screens. To be able to operate interactive television controls, the legibility of features on the screen must be as clear as possible.

The requirements to operate remote control handsets have become more complex. In particular, pressing buttons on the remote control whilst watching the screen becomes difficult for older viewers with presbyopia, as the ability of the eye to focus at different distances decreases.

With the increase in television functions, more buttons are required on handsets that are already very full. This leaves less room for text labels, which are often already too small.

Integrating smart card and digital technology together, would enable people with special requirements to configure a system to meet their needs.

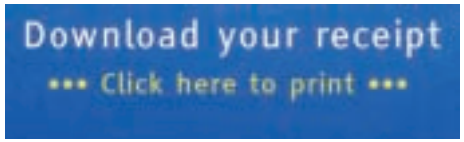
Mobile phone handsets could replace the remote control for televisions and recorders. Many of the new mobile phones (such as the Nokia below) have larger screens. Devices such as this could provide an interactive channel (for services such as tele-shopping) while connecting to the television using wireless systems such as Bluetooth.

Typefaces and legibility

Text when displayed on a television screen is made up of multi-coloured pixels, which tends to soften the appearance of text. To ensure that interactive television is easy to use, it is important that typefaces chosen to display text are suited to the medium and that they are used in ways that ensure maximum readability. Tiresias Screenfont is a typeface that was specifically designed for subtitling on digital television.

DVDs

Videos can be a useful medium for disseminating information about the services provided by an organisation. DVD has the advantage that there can be more than one soundtrack (e.g. for ethnic minority languages) as well as optional subtitling in various languages. For visually impaired users, audio description can be beneficial; this is where descriptions of the visual aspects are inserted in the gaps in the dialogue. People with a hearing impairment would benefit from a sound track without background noise or music; on a DVD this could be a separate sound track.



www.tiresias.org/guidelines

Smart housing

Currently 'smart housing' is seen by many as just sophisticated devices that enable people to control music systems, lighting and curtains. But for many elderly people or persons with disabilities smart housing could provide valuable support in their daily lives.

The technologies are now available to allow wireless communications in sheltered accommodation, alarm systems, closed circuit television, security and monitoring systems.

People who need support can be less isolated through the use of videophones, the internet and e-mail. Telemedicine and telecare can open up better levels of information, communication and interaction.

However, this requires the user interface to be designed so that it can be used by people with low vision or other disabilities.

The need for visionary design

Allowing people who are elderly or with disabilities to live with some level of independence has always been a problem for those charged with their care. Many people like to be in their own homes or live as independently as possible in a place designed to provide care and support.

Local authorities and care organisations constantly explore different types of care environments and sheltered accommodation. Concepts in smart housing, if well designed, can open up highly advantageous possibilities for both care organisations and individuals.

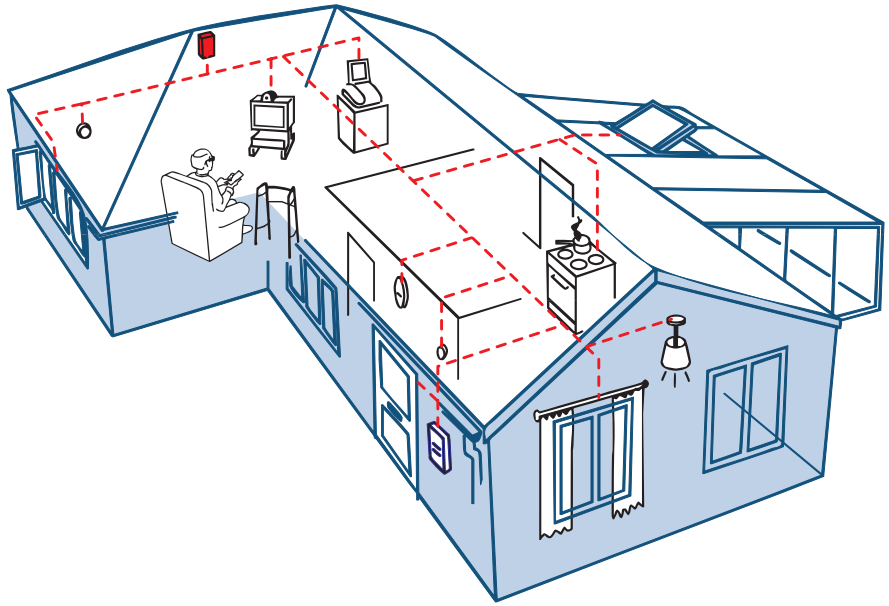
Regardless of which technologies are used, the user interface is likely to be one of the most important features. This in itself is a design challenge. As can be seen from the current design of television controls, a consistent and easy to understand interface has yet to be developed.

A well designed interface and control system that could be easily adapted to a person's special needs must form the basis for the development of effective support systems. Standardisation in connectivity would also be very important.

If devices such as CCTV, videophones, audible systems, alarms, sensors and switches were easy to connect and easy to configure a whole range of communication, support and monitoring systems could be designed.

The use of wireless systems, such as Bluetooth or ZigBee, could dramatically decrease the cost of installing smart systems in an existing home. Wireless systems also simplify the process of modifying the system when the user's needs change or a new resident takes over the accommodation.

To provide sufficient support to give an elderly person confidence to continue to live independently may only involve a modest investment, which later can be re-used for another individual. Common concerns among elderly people are personal security, remembering to take medication and the ability to call for help if they have a fall.



Possible applications

Examples of how smart housing design can help are: personal alarm system detectors can notify family, friends or emergency services. In more remote districts telecommunication links will enable some medical services to be provided direct to the home. A video telephone link to a service centre could provide many people with a reassuring link to family, friends or assistance; this can be very helpful to people with intellectual impairments. Audible feedback for blind users can help indicate whether such things as curtains are open or closed. On leaving a building, a verbal description or visual display of current status can advise about windows left open or electrical devices switched on.

Telemedicine

Advances in information and communication technologies are changing the ways healthcare is delivered. The internet is at the forefront of a change in the way information is available. In remote areas video links enable doctors to advise patients at a distance.

Many believe that telemedicine and telecare technology has proved itself both technically and clinically. Now the key issues concern the way the introduction of these services is managed so as to maximise the benefits for patients and healthcare services.

Smart cards

Smart cards can carry very specific information about a person, such as health records. Smart cards can also be used to help people control devices. For example an electronic medicine dispenser could be designed to release specific tablets to a person, which could help avoid the difficulties some people have in remembering what tablets to take or at what intervals.

With the increasing number of older people, it will be essential to make use of appropriate technology since the cost of such technology is usually modest when compared with the cost of residential care.

These pages show some examples of the guidelines on smart housing. The guidelines cover:

- Wireless systems
- Visual alarms
- Intelligent alert
- Cameras and screens
- Telemedicine
- Telecare

www.tiresias.org/guidelines

e-Government and e-Learning

e-Government is the introduction of electronic methods of improving the way Government performs it's business.

The UK Prime Minister, Tony Blair, has set revised targets for all Government services to be offered online by 2005. This includes the aim to have e-enabled elections with the capacity for an e-enabled General Election some time after 2006.

The current principal access channels for e-Government are:
- **Telephones**
- **One-stop shops**
- **Web sites**
- **Digital TV**

Although the accessibility of web sites is being addressed, there remain significant accessibility problems with other media such as interactive television.

Why e-Government?

e-Government can offer services to citizens by providing them with greater access to information; to businesses by providing a single point of access for administrative information and requirements and between administrations. Here, e-Government can provide ways to enable a structured interaction between national, regional and local Government. Commitment to the future implementation of e-Government can also be seen across Europe and in the USA.

Currently, in the UK, projects are underway to use e-Government systems to improve cost effectiveness, reduce inefficiency and transform the services offered to the public in such areas as local authority benefit systems. Other areas include:

- Social care assessment
- Housing repairs and benefits
- Street scene reporting
- Trading standards
- Environmental health
- Building control

It is expected that the main information route for government services will be the world wide web and interactive television.

For many older people interactive television is likely to be a preferred option. However, the current systems for using interactive television are not very accessible. For example filling in forms is not easy. There is also a lack of appropriate help systems, if a person does not know what action to take next.

Designers need to consider the use of possible helpful devices such as smart cards which can store a person's details such as name and address. This could be inserted into an interactive television and help make filling in a form easier.

e-Learning

e-Learning is distance learning using electronic media such as computers, internet and intranet. Learning materials can be accessed from the web or CD via a computer. Tutors and learners can communicate with each other using e-mail or discussion forums. e-Learning can be used as the main method of delivery of training or as a combined approach with classroom-based training.

Universities, such as University College London, use web based courses for the delivery of foundation course materials. Tutors can receive test results and respond by e-mail, allowing students who have difficulty travelling to have ease of access.

New media such as the internet has opened up new possibilities for the sale of technical products for export. Technical manuals and on-line training and demonstrations can be accessed via the web in different languages.

Organisations can also use e-Learning to deliver simple training packages in a cost effective way for such things as health and safety. Employees can access courses from remote locations. It is important to remember that the Disability Discrimination Act requires employers to provide reasonable access for disabled employees.

As e-Learning develops into more and more applications, the difficulties of access for people with disabilities must be carefully considered. It is better to design in accessibility from the outset rather than to have to modify the design after the system has been installed. Testing the ease of use with a cross-section of all types of potential users is very important.

e-Voting

An e-enabled election allows the voter to choose one of the following channels:

- Internet
- Telephone (mobile, workplace or home)
- SMS text messaging
- Digital TV through the remote control
- Mail

Remote voting is voting from any unsupervised location i.e. the home, office or on the street. Remote electronic voting is voting that takes place by electronic means from any unsupervised location.

To ensure that people with disabilities can use these electronic facilities it is essential that design problems are solved for the use of devices that identify the individual, such as smart cards with biometrics.

Ballot machines

Ballot machines are likely to be used extensively in the future in supervised locations. It will be important to ensure that visually impaired voters can use ballot machines with ease. Voice-guidance would help the voter step through the entire ballot in private. Cognitively impaired voters could also use this feature to simplify the voting process.

Easy operation of touch-screens and the ability to position the terminal screen at a suitable angle will help individuals with accessibility problems.

Flexibility and choice

Implementation of e-Voting, especially through remote methods, should be based upon the principles of flexibility and choice, ensuring that voters are not restricted to one preferred method but can choose the method of voting that most suits their lifestyle and preferences.

Privacy

Voters, including disabled voters, expect their votes to be private and for no-one to know how they have cast their votes. It is also important to ensure that the voter has the opportunity to cast their ballot without coercion, and that the voter is confident that the system is secure.

www.tiresias.org/guidelines

Smart media and biometrics

Smart cards

A smart card is a credit card sized plastic card incorporating an integrated circuit. This circuit holds information that can be securely and accurately read by all sorts of terminals. Smart cards are able to carry larger amounts of information than magnetic stripe cards and thus provide the opportunity to make machines much more 'user friendly' than they have ever been before.

Smart cards are likely to be used in a growing number of applications including:

- Public transport
- Credit and debit cards
- Access control
- Health records and prescriptions
- Electronic voting
- Pre-payment for gas and electricity
- Loyalty schemes
- Car parking
- School meals and student facilities
- Membership (e.g. libraries, sports centres)
- Driving licences
- Identity systems
- Telecommunications
- Electronic purses

For disabled and elderly people, a smart card can carry information that tells a terminal to:

- Allow the user more time
- Simplify the choices such as issuing a pre-set amount of money
- Larger characters for people with low vision
- Audio output of non-confidential information.

Card orientation and embossing

Blind persons, and many elderly people, have problems in inserting the card in the correct orientation; this is a particular problem with cards which are not embossed. It is recommended that a 2 mm notch is incorporated in the trailing edge.

A blind person can also have a problem selecting the right card from their wallet. It is recommended that cards incorporate embossed symbols according to the European standard.

Card entry

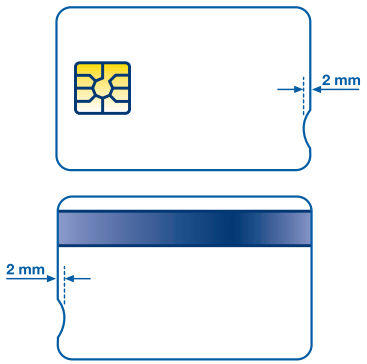
On some machines it is often far from obvious where to insert a card. A flashing light around the entry slot is beneficial. For those with hand tremor, it is useful if the entrance to the card reader acts as a funnel to guide the card in correctly.

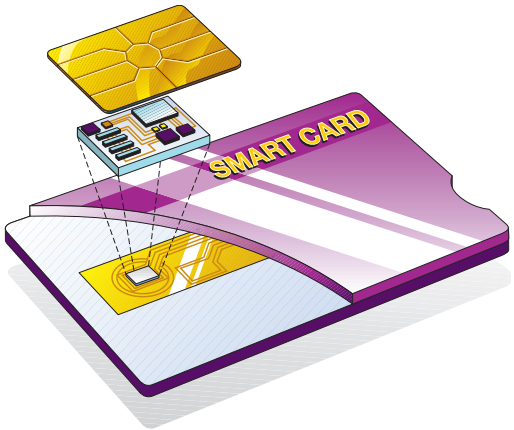
Contactless smart cards

A contactless card can work at a distance of up to 10 cm. These can be helpful to persons who have difficulty placing a card in a slot.

PIN numbers

Many cards use a four digit personal identification number (PIN). People with dyslexia often have problems in remembering a four digit PIN in the correct order, so are likely to prefer alternative biometric systems for authentication.



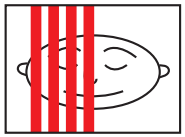


Biometrics

Biometrics permits the automatic identification of an individual based on his or her distinguishing physiological and/or behavioural characteristics. Biometric identification involves comparing with a database of templates to find out who you are, but biometric verification is where the template is compared to the one supplied with your claimed identity. Some biometric systems cannot do identification but can only verify the claimed identity of a person.

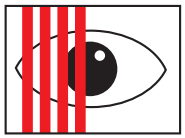
For the user, it should be easy and comfortable to use the system. Many users would prefer methods which do not require physical contact between the individual and the device. Consumers need confidence that the system will reliably correctly identify them while not permitting other users access; no current biometric system achieves 100% success in both these aspects.

It is important that clear instructions are provided on how to use a biometric system. To establish consumer confidence, it may be necessary to provide human assistance for first time users.



Facial imaging

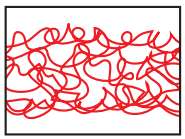
Hand and finger geometry



Iris pattern

Dynamic signature

Voice



Vein geometry

Keystroke

Biometric technologies include:

Facial recognition

Facial recognition can have an unacceptable level of either false positives or false negatives. It is technically best used to say "is this the same person" rather than "who is this person". Thus it is an appropriate technology when used with a secure token such as a smart card. From the users perspective it's non-intrusive nature is a major advantage and users are likely to accept such a system if it can provide a decision quickly, and is seen to be protecting their interests.

In passport applications, a false rejection will only result in a referral to an immigration officer who can handle problems such as changes in facial appearance.

Fingerprint systems

Fingerprint systems are good for the low number of false acceptances, but can be problematic for those with damaged fingers or with prosthetic hands. Some users will associate fingerprints with criminal investigations, so may be reluctant to use the system.

Iris recognition

Iris recognition is a secure system, but the user has to position their eye in relation to a camera. This can give problems for users who are very tall, very short, or in a wheelchair. There are obvious problems for users who are blind or have a visual prosthesis. In addition some ethnic and religious groups may consider such a system unacceptable.

Updating

The biometric information can be stored in a central database or on a smart card. Users are likely to prefer the information to be stored on their card rather than on a remote database. However, it is easier to regularly update the database with revised biometric data as the user's characteristics change.

Users should have the facility to choose an alternative verification system even if it is a PIN. However this choice may be subject to regulatory or legal requirements imposed on the service provider. The user should be advised if the alternative is less secure, but the decision to use an alternative system should be left to the user.

Controls

During a normal day most people interact with a wide range of switches, keypads, instruments and machines – operating televisions and radios, ticket machines, telephones, washing machines, cookers and computers.

When considering the needs of elderly people and persons with disabilities, it is necessary to be aware that having little or no vision, poor manual dexterity or weak grip can make using the machines and tools in our everyday lives very difficult. Lack of foresight and thought into the way people interact with machines can mean that the application of the technologies that allow us to create sophisticated tools can also deny access to a significant section of the population.

Locating controls

For a blind person it may not be obvious where the controls are located if they are not in a standard position. It is important that controls are grouped in a logical manner, and that they can be differentiated by shape, size and colour as well as position.

Layout

The layout of controls should reflect the sequence of operation (e.g. left to right, or top to bottom). Consistency of layout is essential for users not familiar with a particular terminal.

Labels and icons

Text and icons must be clear, not too small and have sufficient contrast to help people with impaired vision. It is helpful if text or icons are positioned so that they are not obscured when the controls are being operated.

Colours

Colours such as red and blue are commonly used to distinguish hot and cold. However, status should not be indicated by colour alone since a significant portion of the male population has problems distinguishing red/green or blue/yellow. People with retinitis pigmentosa often have difficulty reading red displays.

Relative and absolute controls

Controls which change the relative, rather than absolute, values often cause problems for people with low vision. A blind person may find it difficult to judge where a slider switch is positioned in relation to the upper and lower limits of the scale. A person with decreased manual dexterity may find it difficult to operate a control which has to be moved from side to side.

Multi-function controls

When the same control is used for a number of different functions, older users can easily become confused. Often it is preferable to have a larger number of buttons laid out in a logical manner rather than use multi-function controls.

Touchscreens

As touchscreens become more common it is essential that they are designed for ease of use by everyone, including disabled and elderly people.

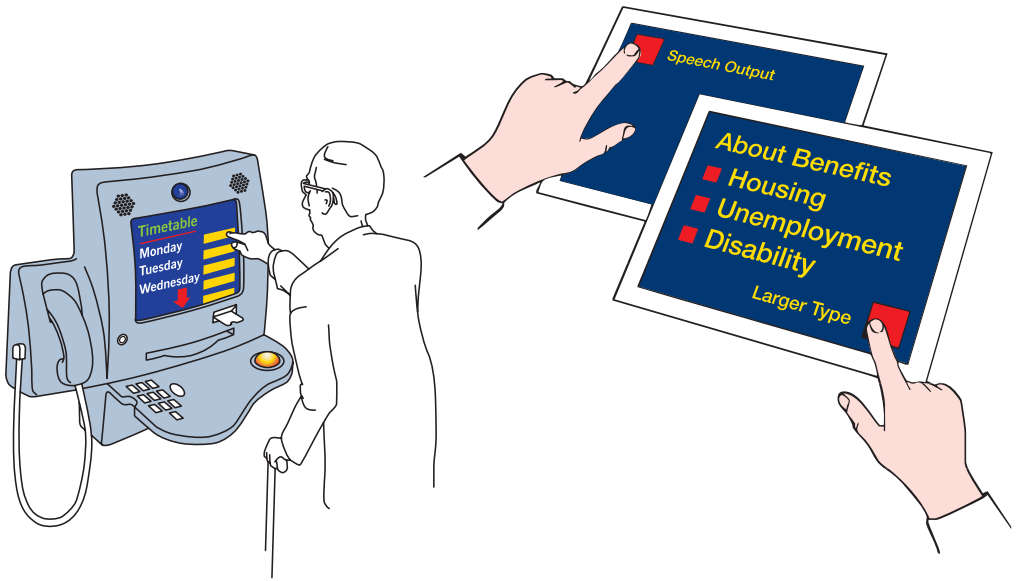
Activation

Touchscreens can either be triggered by insertion or withdrawal of the fingertip. With the latter system, it would be possible for the user to pass their fingertip over the screen and get speech output describing the active area being touched at the time. Then the system is only triggered by withdrawing the fingertip from over an active area.

Ease of use

To help elderly people and those with hand tremors, active fields should be as large as possible and separated by a 'dead area'. There should be high contrast between touch areas, text and background colour. Colourful patterns or pictures in the background can make a screen difficult to read.

Screens should be positioned so that they are shaded from overhead lighting or sunlight which will reflect glare.



Larger type

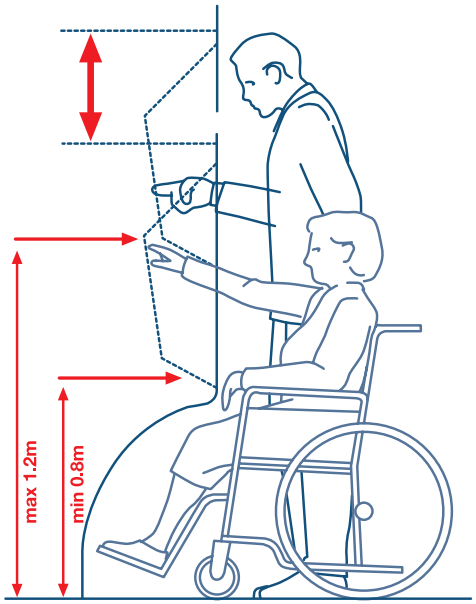
It is possible to increase the size of the characters on the screen for individual customers who require this facility. This can be done by selecting this option from a menu or, preferably, by storing this information on the customer's card. With touchscreen systems, it could be arranged that holding one's finger in the bottom right corner for at least two seconds indicates that one would like larger characters on the screen.

Screens should be as large as possible so that larger text can be used. Larger screens also allow more space to position text and active areas.

Wheelchair users

To use a touchscreen from a user-propelled wheelchair, the height of the active areas should be between 800mm and 1200mm for most users. Also, the screen should be perpendicular to the line of sight. If the terminal is also to be used comfortably by standing users, this may involve using two screens or a variable height screen.

A recessed space beneath the terminal will make it easier for a person in a wheelchair to get as close as possible to a screen.



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Keypads

Consistency in the layout of keypads is essential for blind users and highly desirable for other users. It is also important to set out the keys in a way that makes it easy to distinguish between the main numerical keys and other function keys. Variation in the size, shape and position of function keys will help differentiation.

There are currently two common layouts for numeric keys; the telephone layout and the calculator layout. A standard layout for keypads is essential for blind people. It is recommended that the telephone layout be used exclusively on public access terminals.

Some devices have buttons that have more than one function, some involve time delays or the need to be able to hear an audible response. If no consideration is given to the needs of people with disabilities then even a simple operation sequence can be unworkable and leave people excluded. In the ideal world, systems will automatically learn from the way the user controls a system, and modify the user interface to optimally meet their needs.

The arrangement of keys

Function keys should be clearly separated from the numeric keys. When command keys are vertically arranged, 'cancel' should be the uppermost key and 'enter' the lowest. When the command keys are horizontally arranged, 'cancel' should be located the furthest left, 'enter' the furthest right. It is better to position the command keys to the right of the numeric keys, since they are then less likely to be inadvertently touched when entering numerals.

Where command keys are positioned beneath the numerical keys they may be a problem to visually impaired persons because they are likely to be pressed accidentally when entering numbers. Command keys should be as large as possible so that the words on them can be larger and thus easier to read.

Visual markings on the keys should be characters at least 4 mm high and should have good contrast with the colour of the key (e.g. white characters on matt black keys).

On numeric keypads which also include up to 4 alphabetic characters, the size of the alphabetic characters should be as large as possible without affecting the legibility of the numerals (NB for most users, the legibility of the numerals is more important than the legibility of the alphabetic characters); the spacing between the alphabetic characters is as important as the size of the character, since it is the characters which are being read and not a word.

Typefaces

Large clear typefaces should be used to improve legibility for persons with low vision. When choosing typefaces it is important to use characters that have clear 'open' shapes. Many people with low vision can easily misread such characters as 3, 5, 6, 8 and 9 if the tails curl over; this tends to blur or merge the shapes.

Tiresias Keyfont is one example of a typeface specially designed for use on keypads.

Shaped keys

Colour should not be the only distinguishing feature between keys, since red/green colour blindness is not uncommon; if possible, the keys should have different shapes and be marked with symbols.

Enlarged raised keys enable persons with poor dexterity to press the correct key; a concave shape to the keys will also help fingers to stay in place. The spacing between the keys is as important as the size of the keys. When a person has difficulty making precise finger movements, large keys that are recessed or guarded can help ensure that the wrong key is not pressed.

Illumination

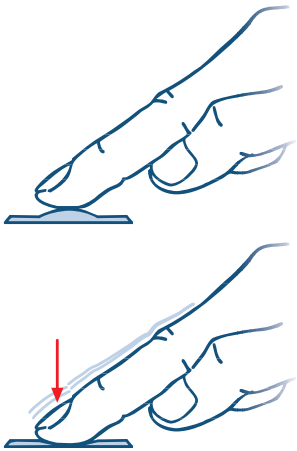
Ideally keys should be internally illuminated when the terminal is waiting for input from that keypad.

Sound

Auditory feedback in the form of sounds such as a 'beep' or 'click' when a key is pressed is helpful to many people and enhances feedback and subsequently performance.

Tactile feedback

Tactile indication can be provided by a gradual increase in the force, followed by a sharp decrease in the force required to actuate the key, and a subsequent increase in force beyond this point for cushioning.



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Visual displays

On most terminals the visual instructions on the screen are the main guide for the user. There are a large number of factors that determine whether reading the screen will be difficult or easy for disabled or elderly persons.

Screen position

Sunlight can degrade the viewability of the display for all users. The screen should be shielded from direct or reflected sunlight or other bright light sources. The display should be viewable from the eye level of a person sitting in a wheelchair. People with low vision should not be prevented from getting their faces close to the screen.

Parallax problems

The conflicting requirements of tall pedestrian users and short wheelchair users can lead to a significant group of users having parallax problems when lining up the function keys with the displayed option. Lines on the user-interface leading from the key to the surface of the display can alleviate this problem.

Legibility and typefaces

Good standards of legibility help all users, but for many people with low vision the issue is fundamental to being able to read information and prompts on displays.

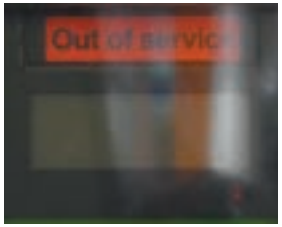
Many screens are too small and too dark to display information in a way that can be clearly seen. Larger screens and clear graphics, with strong contrast between the characters and the background all help improve legibility. Adjustment of the size of text should be allowed.

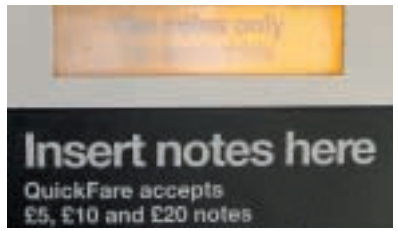
Other languages

Other languages may also need to be included. The instructions for this could be included on a smart card.

An example of the checklist on the guidelines:

- Have you allowed for red/green and blue/yellow colour blindness?
- Is the screen protected from glare?
- Is the screen readable from a wheelchair?
- Can the user adjust the angle of the display?
- Can the user get close to the screen?
- Can the user increase the character size?
- Have you used a legible typeface?
- Is the text on a plain background?
- Have you used scrolling or flashing text?
- Have you minimised parallax?
- Is the language selectable?
- Have you used standard icons?





Typefaces

Many older people have difficulty reading standard text even with spectacles and good illumination. To help with this problem choosing a clear typeface will be very important in helping ensure the best levels of legibility for any application.

For people with low vision some numerals such as 6, 8, and 9 can look very similar. In some typefaces characters such as the lower case '**l**', the numeral '**1**' or an upper case '**I**', as shown below, can be difficult to distinguish. Increasingly password and e-mail addresses use a combination of letters and numbers. For such applications it is essential to use a typeface which clearly differentiates numerals and letters.

3 6 8 9 J I l 1
Tiresias Infofont

3 6 8 9 J I l 1
Helvetica

3 6 8 9 J I l 1
Times

The RNIB Scientific Research Unit has produced a range of typefaces for applications where legibility is important.

Tiresias Screenfont was designed for subtitling on UK digital television. It has been specifically designed for screen display and has been adopted by the UK Digital Television Group as the resident font for digital terrestrial television.

Tiresias PCfont is a typeface designed to display clearly on screen based systems. When a typeface is generated on a screen, the character shapes are created on a grid of fine lines or pixels. Because most traditional typefaces were designed for reproduction on paper rather than screens their subtle shapes are often distorted on screen.

Tiresias Infofont has been designed for use on information labels and controls to help improve legibility. The characters and letterforms have been designed for a reading distance of 30-100 cm. This typeface has been used for applications such as fire notices and labels in museums.

Tiresias Signfont is a bolder typeface, but has characters that have been designed to maintain open shapes that provide maximum readability at longer distances.

Tiresias LPfont is a large print typeface designed for use in publications. Large print publications should be designed to specifically help with reading problems, and should not be just an enlarged version of ordinary print.

Tiresias Keyfont has been specifically developed for use on the keypads of ATMs, chip and PIN terminals, telephones, ticket machines, domestic appliances, computers, office equipment and remote control pads.

ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz
0123456789 **Tiresias LPfont**

0Ø Distinguishing a capital 'O' from a zero

In some applications where the context does not make the meaning obvious, it is essential to be able to differentiate the zero and the capital 'O'. In this case it may be necessary to use a cancelled zero. The Tiresias fonts include this optional feature.

www.tiresias.org/guidelines

Pictograms, icons and symbols

Understanding the meaning

Pictograms, icons and symbols appear to be used on buttons and controls with very little thought as to how people might understand their meaning. Wherever icons are used they should be easy to understand, otherwise they will add to the difficulties of using controls. This applies particularly to machines that a person might encounter only occasionally and thus may have to operate the machine without training or other instructions. One example of potential confusion is the 'Enter' button, shown below. On most keypads an arrow like this is used to indicate 'Enter' and yet this is a symbol that has remained in use from old style typewriters, indicating a 'carriage return'. The meaning of this is not obvious unless you are old enough to remember moving carriage typewriters.

Icons such as this and the icon for on/off, shown on the green switch, below, seem to evolve with little thought to the difficulties users might have in understanding them.

A standard design for the most frequently used control icons will be of benefit to all. The addition of appropriate words alongside an icon is important if users are to avoid the need to guess the meaning of the icons.

Visual contrast is important if text and icons are to be easy to see. Subtle colours and small text make it very difficult for people with low vision.

Tactile

On outdoor terminals, braille has limited value in cold weather since tactual sensitivity is dramatically reduced. However, on the packaging of such items as aerosols of oven cleaner, the introduction of an embossed triangle to indicate dangerous substances has been helpful to blind people so that they do not confuse it with an aerosol of hair spray.

Colours

Colours alone should not be used to indicate status or an action, since a significant portion of the male population has problems distinguishing red/green or blue/yellow. People with retinitis pigmentosa often have difficulty reading red displays.

Labels

The position of labels with text or icons is crucial for an unfamiliar user with impaired vision. All too often labels are positioned in a way that they are obscured from the user's view when the controls are being operated. The problem is particularly common when the control panel is at an acute angle to the user's line of sight or at an inappropriate distance. Allowance should be made for the 10% of the population who are left-handed. Many people with low vision like to get their face close to the control panel to read the labels, or use face-mounted or hand-held magnifiers.

Audio input and output

Synthetic or digitally stored speech can be used for:

- Prompts or fixed messages (e.g. next stop on a tram).
- Error or help messages.
- Output of contents of screen.

If information is confidential, then speech output should be to an earphone (e.g. telephone handset).

For situations with poor viewing conditions (e.g. low illumination or high vibration) audio output can provide another modality of information dissemination or provide more redundancy. Audio messages are most appropriate when an immediate response is required with less reliance on referral to the message at a later date.

People with a hearing impairment often have difficulty in understanding synthetic speech output since it tends to have less redundancy than natural speech. The facility to repeat a message is frequently essential rather than just desirable.

Voice control

Voice control can be beneficial in situations where more than one task is performed simultaneously which require both hand and/or eye co-ordination. It's limitations include technological constraints which limit the vocabulary size and speed of accurate processing. Feedback of a mistake may interrupt other activities.

Accuracy of voice recognition systems deteriorates significantly if there is background noise. Accuracy is improved by allowing a limited choice of commands which should include common alternatives such as 'start' or 'begin'.

Microphones

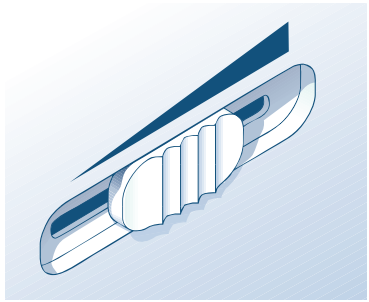
A sensitive microphone will help persons with quiet voices or with restricted neck and chest movement that makes speaking difficult. It is also important for the user to be able to adjust the sensitivity of the microphone so that it can be used by either a person with a weak voice or a normal voice.

Amplification

Amplification of the microphone should be user controlled and should automatically reset for the next user.

Speech input

Speech input keying is a useful means of providing a hands-free facility for users with reliable voice, and may be valuable even where full hands-free operation is not necessary (e.g. when hand tremor interferes with manual keying). Speech input is also useful for dyslexic users who can read aloud and simultaneously enter keys thus avoiding short-term memory problems.



Recommendations in the guidelines include:

Audio output

- Provide user control of volume of audio output.
- For acoustic signals to attract attention, use a frequency between 300Hz and 3000Hz.
- Messages should be simple and short.

Audio input

- Minimise background noise.
- Ensure that the microphone can be used by people in wheelchairs as well as by people standing in front of the terminal.
- Provide alternative method of input for people with a speech impairment (or with a strong accent).
- Provide recognition feedback after each input.
- Provide opportunity for the user to undo incorrect inputs.

Wireless systems

Wireless systems

Wireless systems either use infra-red or wireless signals to communicate short distances. Various systems are under development for a range of applications but they have developed differently depending on what has been viewed as the primary application area.

The advantages of wireless systems are that devices, machines and terminals can communicate with each other without the need to be physically connected. This means that in applications such as smart housing devices such as door bells, monitoring systems, CCTV cameras and control systems can be interconnected. In areas such as sheltered accommodation a care manager could have access to a set of monitors that would allow them to receive information and alert warnings.

It would be important not to invade on a person's privacy but it would be possible for wireless system monitors to report on whether devices such as cookers were being left on, or whether doors and windows were left open.

Wireless systems can be designed to be simple to set up and also to re-configure. The application in care homes or smart housing could thus be cheap to operate if properly designed.

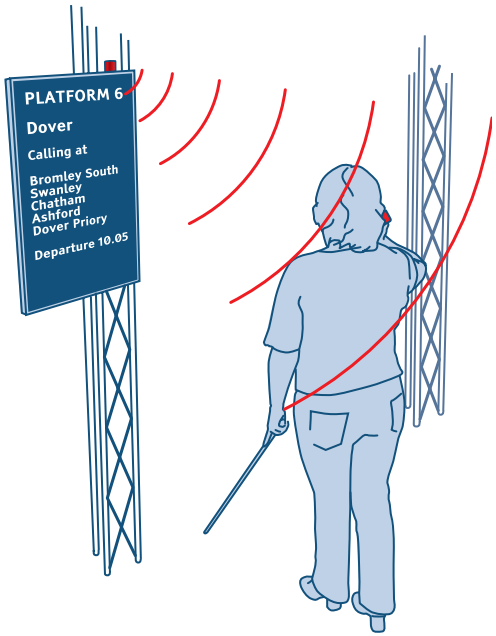
At the present time, the main application areas for wireless systems are:

- Personal area networks (e.g. Bluetooth) for applications involving the connection of mobile phones to headsets or personal digital assistants (PDAs).
- Local area networks (e.g. Wi-Fi) for applications involving the connection of a laptop computer to a computer network (in an office complex or at a 'hot-spot' such as an airport).
- Smart housing (e.g. ZigBee) where a device spends most of the time in 'sleep' mode.

However, there are many contenders to supercede the present dominant technologies. Ultra wide-band (UWB) offers particularly exciting possibilities for making life easier for people with disabilities.

Since wireless systems are evolving fast, the period of availability of products for a particular system may be only a few years. This can cause problems if the service provider is looking for a longer period over which to write off the capital cost of the system.

A wireless system that transmitted transport information to mobile telephones within a certain range could be very helpful to a blind person. This is a viable possibility that would be vandal proof and low cost. Other types of public terminals such as cash machines could also use this type of system.



Interface to assistive devices

The Tiresias guidelines outline the main assistive devices and services and give examples of the type of information to be transmitted to and from a device. Over the next few years more wireless technologies will be developed and many of them will have higher bandwidths (e.g. for transmitting video).

When designing assistive devices it is important to consider whether:

- Standards are uniquely defined
- The interface is in widespread use for the relevant ICT systems
- The interface is relatively inexpensive in relation to the cost of the ICT system
- The interface system is reliable in all relevant environments.

In the past only a few standards have met these criteria.

Training, instruction books and help facilities

Training

The requirements to use public terminals and different types of machines has led to a real need for different levels of training. People can often be seen in front of ticket machines or terminals reading instructions and trying to work out how to carry out tasks. Some machines are well designed with logical instructions, others are very badly designed with instructions scattered around and difficult to read.

On some bus systems it is necessary to purchase tickets before boarding. However, very little thought has been given to the design of the ticket machines. If the machines are difficult to understand with poor instructions, a person who is visually impaired or has poor manual dexterity can find themselves in real difficulty just trying to use a bus.

All too often, designers of self-service machines and service providers assume that users will learn to use the system without any training. For many disabled and elderly persons this is not the case, so they decline to use the terminal.

A combination of well planned design and the provision of training or good quality assistance is needed. Consistency in the design of user interfaces will also reduce confusion.

Instruction books

The writing of instruction books should not be left to the end of a design project. Instructions should be tested on a range of potential users. The technical designers of a system should not be the only persons to write instructions, especially for non-technical users.

It will be of help to all people if information can be delivered in different ways and with thought for those with impairments. Alternative formats, such as large print and audio tape, are essential to visually impaired and dyslexic users. New technologies such as wireless systems and smart cards make it possible to design new ways to deliver information.

Help facilities

Having problems in using an ICT system is not unique to disabled and elderly people, but they are more likely to have problems. A well designed system will provide, at the right time, appropriate relevant help in a form suitable for the user. However it is easier to specify than to implement, but this should not be used as an excuse for ignoring the problems faced by users and potential users.

Error messages must be in a meaningful form for the user so that they understand why it happened and what they need to do to rectify the situation. It is important that they are not "timed out" while correcting their errors.

Error messages should not put the blame on the user, and should appear within a few seconds of the error occurring. The user should be able to go back to the task being performed just before the error occurred.

When it is practicable, many users would find it beneficial to obtain some human assistance. This may just be an audio link (e.g. via a telephone handset), but many intellectually impaired and hearing impaired users would prefer a video link.

The guidelines include the following recommendations:

- Guidance should be readily distinguishable from other displayed information.
- Provide the user with specific information relative to the task context rather than a generic message.
- Provide information on how to recover from errors.
- Indicate permitted range of values or syntax for user response.
- Ideally, multi-modal help should be provided.
- Allow skilled users the option of switching off help prompts if they are not required.
- Keep spoken messages short and simple.
- Do not use abbreviations in audio messages.
- Allow users to interrupt the help at any time and return to the task.
- An intelligent help facility is not an adequate solution to a poor user interface.

www.tiresias.org/guidelines

Legislation

Some countries have developed policies regarding accessibility of information technology and web sites (Australia and the United States of America); others provide more generic accessibility coverage (India); still others cover only access to technology for all, with no mention of people with disabilities (Argentina).

United Kingdom

In 1995 the Disability Discrimination Act (DDA) was passed to introduce new measures aimed at ending the discrimination which many disabled people face. It protects disabled people in the areas of:

- employment
- access to goods, facilities and services
- the management, buying or renting of land or property
- education

Part III of the Act is based on the principle that disabled people should not be discriminated against by service providers or those involved in the disposal or management of premises.

Subject to certain exceptions, Part III of the Act applies to any person or any organisation or entity that is concerned with the provision in the United Kingdom of services (including goods and facilities) to the public or a section of the public. Similarly, the Act applies to disabled people who use, or seek to use, the services so provided, whether as customers, buyers, shoppers, consumers, clients, patrons or service users

The Act makes it unlawful for a service provider to discriminate against a disabled person:

- by refusing to provide (or deliberately not providing) any service which it provides (or is prepared to provide) to members of the public
- in the standard of service which it provides to the disabled person or the manner in which it provides it
- in the terms on which it provides a service to the disabled person.

It is also unlawful for a service provider to discriminate in:

- failing to comply with any duty to make reasonable adjustments in circumstances in which the effect of that failure is to make it impossible or unreasonably difficult for the disabled person to make use of any such service.

Some of the services that are covered are those provided to the public by local councils, Government departments and agencies, post offices, banks, building societies and telecommunications organisations.

Reasonable adjustments

The duty to make reasonable adjustments for disabled people is a cornerstone of the Act and requires service providers to take positive steps to make their services accessible to disabled people. This goes beyond simply avoiding treating disabled people less favourably for a disability-related reason. The duty to make reasonable adjustments comprises a series of duties falling into three main areas:

- Changing practices, policies and procedures
- Providing auxiliary aids and services
- Overcoming a physical feature by:
  - removing the feature,or
  - altering it, or
  - avoiding it, or
  - providing services by alternative methods.

A service provider has had to take reasonable steps to:

- change a practice, policy or procedure which makes it impossible or unreasonably difficult for disabled people to make use of its service
- provide an auxiliary aid or service if it would enable (or make it easier for) disabled people to make use of its services
- provide a reasonable alternative method of making its services available to disabled people where a physical feature makes it impossible or unreasonably difficult for disabled people to make use of the services.

From 1 October 2004, where a physical feature makes it impossible or unreasonably difficult for disabled people to make use of services, a service provider will have to take reasonable steps to do one of:

- remove the feature
- alter it so that it no longer has that effect
- provide a reasonable means of avoiding it
- provide a reasonable alternative method of making the services available.

The Act does not specify that any particular factors should be taken into account. What is a reasonable step for a particular service provider to have to take depends on all the circumstances of the case. It will vary according to:

- the type of services being provided
- the nature of the service provider and its size and resources
- the effect of the disability on the individual disabled person.

However, without intending to be exhaustive, the following are some of the factors which might be taken into account when considering what is reasonable:

- whether taking any particular steps would be effective in overcoming the difficulty that disabled people face in accessing the services in question
- the extent to which it is practicable for the service provider to take the steps
- the financial and other costs of making the adjustment
- the extent of any disruption which taking the steps would cause
- the extent of the service provider's financial and other resources
- the amount of any resources already spent on making adjustments
- the availability of financial or other assistance.

Changing practices, policies and procedures

Practices, policies and procedures relate to the way in which a service provider operates its business or provides its services. This includes any requirements that it makes of its customers. In principle, the terms cover:

- what a service provider actually does (its practice)
- what a service provider intends to do (its policy)
- how a service provider plans to go about it (its procedure)

Example of good practice:
A medium-sized supermarket installs one extra-wide check-out lane intending it to be available to customers who are wheelchair users or accompanied by infants. However, that check-out lane is also designated as an express lane available only to shoppers with 10 or less items. The effect of this practice is to exclude wheelchair-users from taking advantage of the accessible check-out unless they are making only a few purchases. It is likely to be a reasonable step for the supermarket to have to take to amend its practice by designating another check-out lane as the express lane.

Providing auxiliary aids and services

A service provider must take reasonable steps to provide auxiliary aids or services if this would enable (or make it easier for) disabled people to make use of any services which it offers to the public. The Act gives two examples of auxiliary aids or services: the provision of information on audio tape and the provision of a sign language interpreter.

Examples of good practice:
A building society provides information on an audio tape about its savings accounts. A customer with a visual impairment can use the audio tape at home or in a branch to decide whether to open an account. This is an auxiliary aid.

A department store has a member of staff able to communicate with deaf clients who use British Sign Language. This is an auxiliary service.

An auxiliary aid or service might be the provision of a special piece of equipment or simply extra assistance to disabled people from (perhaps specially trained) staff. In some cases a technological solution might be available.

Example of good practice:
A large supermarket provides specially designed shopping baskets and trolleys which can be easily used by disabled shoppers in a wheelchair or with reduced mobility. It also provides electronic hand-held bar code readers with synthesised voice output which helps customers with a visual impairment to identify goods and prices. These are auxiliary aids which enable disabled shoppers to use the supermarket's services.

Advice and consultancy

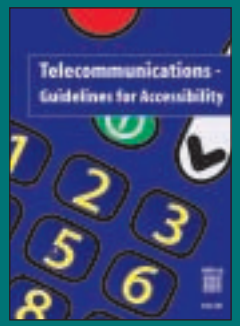
The RNIB Scientific Research Unit can advise on all aspects relating to the accessibility of information and communication technology systems by people with disabilities. The Unit can also provide consultancy in the form of staff training or on specific projects.

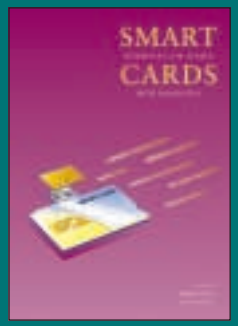
Aims of the Unit:

1. To influence and encourage external research and development of future benefit to blind and partially sighted persons.
2. To influence the design of equipment and systems for the general public such that they are accessible to blind and partially sighted persons.
3. To influence the development of relevant standards.

The Unit has produced a wide range of publications which can be found on the Unit's web site:

www.tiresias.org





Circulation list

If you would like to be included in the circulation list for future publications in this area, please write to: Dr John Gill OBE FIEE, Chief Scientist, Royal National Institute of the Blind 105 Judd Street, London WC1H 9NE. E-mail: john.gill@rnib.org.uk

The guidelines have been developed with the help of CEN/ISSS (Information Society Standardization System) Workshop on Design for All for Information and Communication Technologies, within the context of the work on "Guidelines to Standardizers of ICT products and services in the CEN ICT domain".

BIONIC

The development of the guidelines has been achieved within the framework of the BIONIC project which is funded by the EPSRC and the DTI (Department of Trade and Industry). This project is based on the idea that many of the problems car drivers encounter (trying to find and operate controls whilst looking at the road ahead) mirror those that blind people face. BIONIC set out to learn from the experiences of blind people to help in the design of controls and switches for both car drivers and blind people. It is hoped that this will lead to an improvement in both road safety and blind people's access to new technology.

smart

The National Smart Card Project has brought together the knowledge and expertise of local authorities and Government departments in order to develop and drive smart card solutions across the country.

A number of local authority smart card schemes and initiatives are already in place and this project pulled them together and joined them up to create a model smart card scheme that offers citizens across England access to seamless service delivery using the latest technology.

Eleven work packages drew on current experience and reached out into new arenas to establish a framework for functional smart card solutions.

The key deliverables of the National Smart Card Project are to:

- Improve access to services for citizens and promote social inclusion and opportunities for life.
- Put forward business cases for smart cards.
- Develop business and financial models.
- Produce a standards framework that supports recognised standards.
- Produce best practice guidelines and toolkits for purchasing and procuring smart cards and smart card technology.
- Produce a Smart Card Starter Pack for use by local authorities wishing to implement smart card technology.
- Identify links with Government departments.
- Provide information and advice to interested parties about the work of the project.

www.nationalsmartcardproject.org.uk

Acknowledgements

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- BT Age & Disability Action team www.btplc.com/age_disability
- Johnson Matthey: www.matthey.com
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Accessibility is not the same as usability