RFID

Smart Cards Systems

Mobile Communications

Wireless Systems

Near Field Communication

Biometric Systems

Web Accessibility

Wayfinding

Location-based Services

Transport Information

Accessibility for Visitors

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In the European Union, with a population of approximately 500 million people, the estimated number of people with impairments, such that they could benefit by using the information systems described in this booklet, are:

Mobility impairment

Wheelchair user: 2 million

Cannot walk without aid: 25 million

Visual impairment

Blind: 2 million

Low vision: 7.5 million

Dexterity impairment

Cannot use fingers: 1 million

Cannot use one arm: 1 million

Reduced strength: 14 million

Reduced co-ordination: 7 million

Speech and language impairment

Speech impaired: 1.2 million

Language impaired: 3 million

Cognitive impairment

Dyslexia: 5 million

Intellectually impaired: 15 million

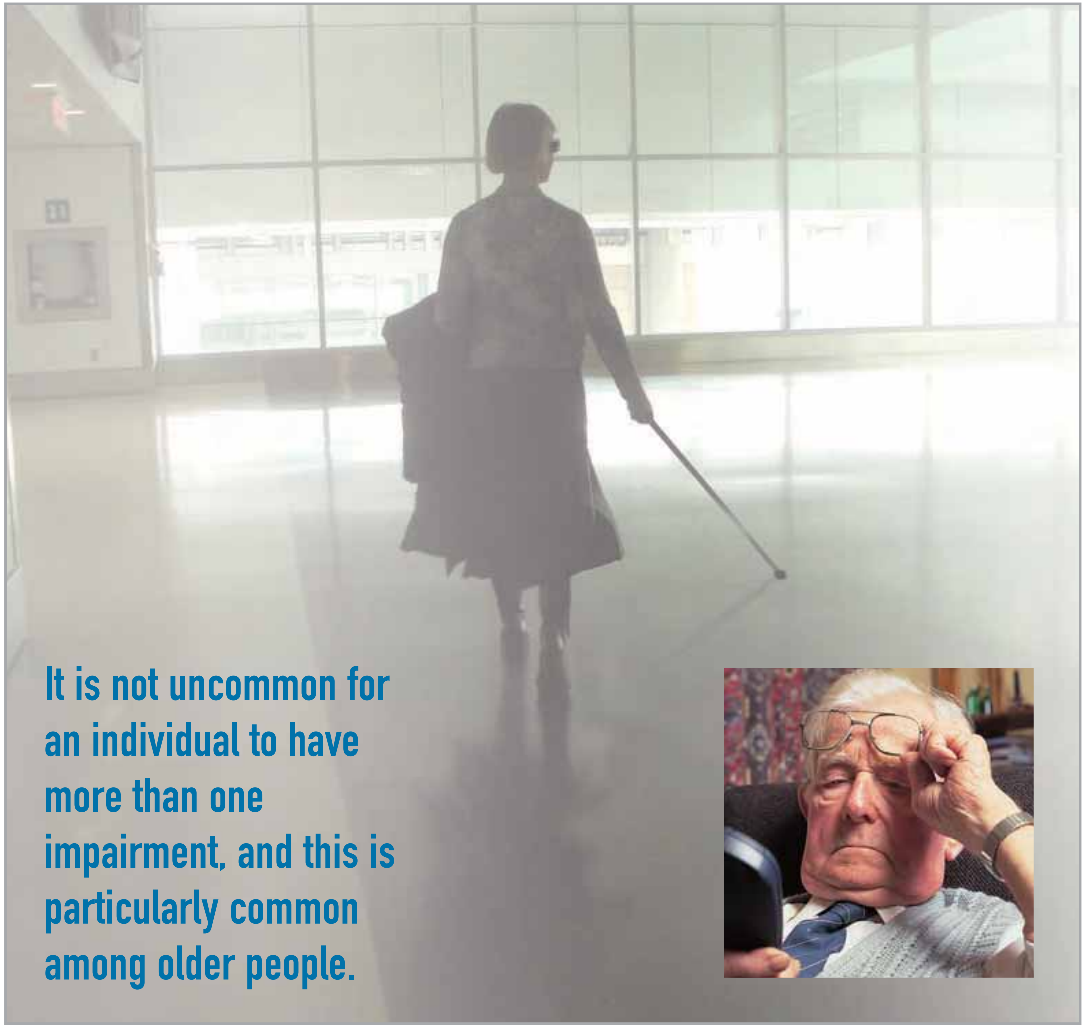
Hearing impairment

Deaf: 0.5 million

Hard of hearing: 30 million

Ageing

Over retirement age: 100 million



It is not uncommon for an individual to have more than one impairment, and this is particularly common among older people.

Accessibility for Visitors

who are blind or partially sighted

How technology can help

Introduction

The possibilities that new technologies can bring to people with disabilities . . .

As well as the 32 million people from overseas who came to visit the UK in 2006, a large number of UK residents also travel to events and destinations within the UK. Throughout Europe people travel to cities, events, museums, galleries, stadiums and festivals. In 2012 the Olympics will be held in the UK.

Visitors and tourists use public transport, airports, hotels, theatres, stadiums and venues. In doing so they need access to information and to use ticket machines, maps, turnstiles, elevators, bus stops, automatic doors, trains, taxis and public telephones.

A significant percentage of all tourists and visitors will be elderly or will have a disability, and there is an increasing requirement to make appropriate provision for people with disabilities. This is partly driven by legislation, but also economic and logistic considerations show that using new technologies can be a major benefit to both the people who need these improvements and the organisations and businesses who provide and manage visitor venues and events.

To date, most of the special provision for visitors with a disability relates to providing access for wheelchairs or the installation of hearing aid loops. However, the advent of a range of new mainstream technologies offers exciting possibilities for providing new services which can greatly help blind and partially sighted visitors, or people with other disabilities, or those who need assistance in other ways. It is important to remember that in most cases improving these services will also be of benefit to non-disabled visitors.

So, what do visitors and tourists need?

Accessible, intelligent information systems

Most information, whether it be about a museum, train times or a sports venue, is provided in print. This is often of limited use to blind and partially sighted people. Therefore, they may rely on other people passing on the information, or they try obtaining the information from the internet. The problem with many web sites is that they are difficult or impossible to use by people who rely on assistive technology such as screen readers with speech output.

A traveller will also need to find out the possible methods of reaching a destination. This may involve more than one mode of transport, and maybe this person cannot walk up more than ten steps. Ideally, there should be a unified information service which can provide this information, taking into account the user's special needs. As well as the total journey time and the total cost of the various options, it would be helpful if the information service was able to indicate where stairways and elevators are situated.

Other information may be needed when a person is actually on their journey. In the event of a service disruption, an information system should be able to reroute the user, taking into account their special needs. Although this sounds futuristic, pilot schemes have been developed to provide such a service.

For partially sighted visitors it is essential that signage has high contrast, preferably with white or yellow characters on a dark background, with a clear typeface. Sign systems that are consistent in the positioning of the signs are highly desirable, together with a consistent use of arrows to indicate direction.

For blind visitors, conventional signage is of limited value. However, an embossed map can be useful if it is combined with non-visual landmarks. A variety of electronic systems have been developed for indicating landmarks. These include beacons which give out an audible message which has been triggered from a device carried by the blind person.

An alternative approach is to use audio guides. Digital systems can be triggered automatically at various locations to provide a flexible range of information. However, these systems are usually restricted to a predefined area.

Satellite navigation systems, coupled to a detailed digital map of the area, are more flexible but are limited to outdoor use where there is line of sight to a number of satellites. It is possible to combine satellite positioning with a mobile phone incorporating a camera so that the blind user calls a service centre to receive audio guidance from a human operator; the operator has a computer display showing the map of the area and the position of the caller combined with photographs from the camera.

This type of system can cope with complex navigation problems such as queues where it is not obvious to the blind person where the queue starts or even the purpose of the queue.

Another complex situation is when an area has to be evacuated since an alarm has been activated. Supplementing visual signals with directional audible signals will help but is not the complete answer in a complex unknown environment.

Machines that are easy to use

On public transport it is often necessary to purchase a ticket from a self-service terminal. Many of these machines are not well designed, in that the instructions can be difficult to read and the sequence of actions difficult to follow. A lack of consistency in the user interface can make a purchase difficult and slow for an occasional user, even for people with good eyesight.

There are many options for improving access to public terminals. For example, the coding on a person's bank card can indicate their preferences, such as large characters on the screen.

In the foreseeable future a pre-purchased ticket may be held within a mobile phone handset or a PDA and the user just touches the handset to the entrance and exit gates in a similar way to a contactless smart card.

Ambient intelligent systems

In the longer term, ambient intelligent systems offer the possibility to provide an integrated seamless system for a range of services.

Ambient intelligence is where people are surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects, and an environment that is capable of recognising and responding to the presence of different individuals in a seamless, unobtrusive and often invisible way. Such a system may store the special requirements of the user (e.g. cannot comfortably climb more than five steps); an intelligent agent could process the output so that the user only receives appropriate information.

This publication briefly describes the main technologies that have the potential to help visitors with disabilities, and how these technologies can be of practical benefit. More detailed information can be found at the web site below, which includes guidelines for system designers.

www.tiresias.org

Radio Frequency Identification Devices

These pictures show two different types of tag. The top picture shows a typical reader. Readers can be much smaller and can be embedded in the tip of a blind person's cane.

Radio Frequency Identification (RFID) is evolving as a major technology with a growing number of uses. Initially it has been used to track goods and assets in retail, manufacturing, hospitals and storage systems, but it has evolved to have many applications outside of these areas. RFID is the technology behind car key-fobs, public transport access (such as the London Transport Oyster card), ski resort lift passes and security badges for access control into buildings.

RFID is a contactless technology that transmits the identity of an object, such as a unique serial number, using radio waves. A typical RFID system is made up of three components: tags, readers and the host computer system.

A RFID tag is a tiny radio device that contains a microchip attached to a small flat aerial. This can be encapsulated in different materials, such as plastic, dependent upon its intended use. A tag can be attached to an object. This object can be read remotely to ascertain its identity, position or state.

The reader, or scanner, sends and receives radio frequency data to and from the tag via antennas. A reader may have multiple antennas that are responsible for sending and receiving radio waves.

The host computer is linked to the reader and can have specialist software designed to process the received data.

When RFID systems are used in conjunction with allied technologies they can remotely sense objects of all types to determine their identity and track their position. They can also be designed to detect other properties.

Because radio waves are used, a RFID tag does not need line-of-sight to operate. The tag can be hidden inside an item or carried on a card or ticket and still be read. A tag can also be fixed to a wall or embedded in a floor. It can then be read automatically as it is passed.

A RFID system can also read many tags together at once. All tags within the range of the reader can be read almost simultaneously as they pass the reader.

There are a range of different radio frequencies in use for RFID tags. An active tag, which incorporates a power source such as a battery, can be read at a far greater range for a given transmitter power. Typically, a passive tag can be read at distances of less than a metre but active tags can have a range in excess of 10 metres.

An important feature of RFID is that data can be written to the tag. The tags can be made with different memory capacities; with extra memory there is the possibility to store extra information. For instance, it could store a list of ingredients. This could be useful for someone with a nut allergy since a simple device could warn them of hazardous products.

Many people, even those with good eyesight, find it difficult to read labels on such things as medicine bottles. With RFID it would be possible for instructions to be transmitted onto a screen so that they can be read using a larger typeface.

Another possibility would be for the washing machine to incorporate a tag reader, and for the tags on clothes to include information about the washing temperature required; then the washing machine could automatically select the correct washing programme.

RFID tags are already used by some blind people to label their possessions (e.g. CDs), and they have a reader with speech output to help them select the correct item. However, there are many more potential applications of benefit to people with disabilities. For instance, active RFID tags could be used to label shops in a shopping centre or exhibits in a museum so that users could obtain audio information about exhibits in a choice of languages.

RFID tags could be embedded in the pavement to give information in audio form to a blind pedestrian. The tags could be part of a painted line, with the blind person using a cane with a transceiver aerial in the tip. The information stored could be the names of shops, bus stops or information about a choice of directions to various destinations.

This illustration shows how a blind person could follow a route that gave them information and options to follow.

RFID tags could be embedded in the floor. The reader, in the blind person's cane, would relay audible information.

A person with low-vision could follow the yellow lines and also pick up audible information.

Smart Card Systems

Smart cards have great potential to make life easier for people with disabilities. There are over a thousand million smart cards in use in Europe today. A smart card is the size of a credit card, and incorporates an electronic chip.

The amount of information this chip can carry and the way smart cards can be used has been evolving over many years. Many of us are familiar with these cards. We use them as pre-paid cards to pass transport barriers (Oyster cards), as credit and debit cards, as security access cards to buildings and for such things as medical or identity records.

Smart cards can be:

- Memory only, for applications such as pre-payment telephone cards.
- Memory plus a microprocessor, for applications requiring more security such as credit and debit cards.
- Proximity, where the card has to be held within 10 cm of the reader – mainly used for public transport applications.
- Vicinity, where the card is between 10 cm and 2 metres of the reader.
- Distant contactless, where the card is more than 2 metres from the reading device – for instance, in road charging applications.

Vicinity cards are not yet in general use but may be used in the foreseeable future for ticketing. The receiving aerial would be around the doorway of the bus, and the maximum fare for the route could be taken from the card on entering the bus and the unused part refunded on leaving the bus. This could be very helpful for a person with a disability who was restricted in their ability to use a city's ticket machines.

For visitors, smart cards that allow pre-payment will help speed up the entry and exit to public transport and also to venues such as sports stadiums and concerts. Where large numbers of people need to be managed, smart cards improve speed of processing payments and the ability to allocate revenues and subsidies between various operators.

Because smart cards can carry specific information, they can be used to deliver this information or instructions to a terminal, an access barrier, a machine, an environment control system, and many other devices. Because it is possible for more than one application to be held on a smart card it is not necessary for a person to have a large number of different cards.

A smart card can hold information on how a person prefers to use a terminal or interface. For example, a person with low vision at a ticket machine may prefer a specific size and colour of text on the screen. People with other disabilities

may need more time, speech or audio output, more simplified choices or a different language. As soon as the person is finished the machine can revert to a default setting.

Smart cards and their use continues to evolve. The amount of information they carry will increase, the range at which they can be used will improve and security will continue to get better.

The EN 1332 series of standards specify:

- Icons for use with card-operated systems.
- A notch in the card to help a blind user insert it into a machine in the correct orientation.
- The layout of keypads.
- Coding of user requirements (such as large characters or more time).
- Embossed symbols to help blind users select the correct card for a particular application.

At a ticket machine or public library, a user's preference card could be inserted into a computer, telling it to use special settings, such as large print. When the user removed the card the computer would snap back to its default settings.

A notch in a card helps a person with low vision feel which way to insert the card into a cash machine, ticket machine or hotel door.

Mobile Communications

Twenty years ago only a few businessmen lugged about heavy expensive mobile phones. Nowadays, no self-respecting teenager is without their mobile which can be customised (both facias and ringing tones) to suit the image required. For teenagers these phones are often mainly used for text messaging. Mobile phones now come with a growing number of additional features such as mp3 music players, digital cameras, television programme downloads, interactive games, etc. As these devices continue to develop, the needs of people with disabilities have been given low priority by the manufacturers and network operators.

Network operators continue to launch new mobile services based on GPRS (General Packet Radio Service) and 3G (third generation), which can provide high speed access to the internet. These include the transmission of data which can be just text, text plus graphics, still pictures, or video.

Plans for fourth generation systems are beginning to be discussed publicly. These are expected to be operational by 2012. An interesting feature is that access by people with disabilities is being considered – an aspect which was notably lacking in the earlier generation plans.

Mobile telephones increasingly require the user to read a small screen to operate many of the functions in the phone. Although the phones incorporate increasingly powerful microprocessors, few manufacturers have seen a commercial opportunity in providing models which incorporate speech output of the messages normally displayed on the screen.

However, changes in the legislation in the USA have meant that manufacturers are now developing a range of accessibility features including output of visually presented information in braille or synthetic speech.

Mobile phone systems have the ability to provide information about the location of the user. In older systems, this was just the cell from which the call was being made. However, 3G systems can provide more precise information, and in future the 4G systems will further improve the accuracy.

This positional information means that information can be provided to the user which is related to their location. For instance, it could provide information about the location of the nearest cash dispenser.

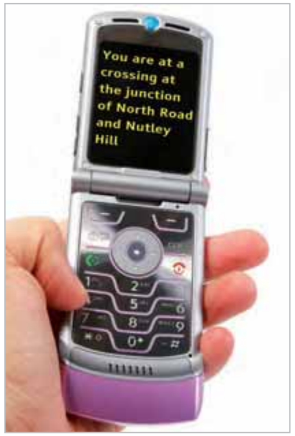
The mobile phone could hold a digital map of the area (or it could be downloaded from the network). This could be supplemented with information about bus timetables or roadworks which block the pavement.

Intelligent agents in the network could automatically re-direct calls selectively to different terminals; for instance, in the evening, calls, other than from family members, would be re-directed to an answering service. For disabled visitors, the calls could be automatically routed via a relay service, enabling translation into other languages or modalities (such as sign language).

The 3G phones have the capability to transmit and receive video which could offer the possibility of someone in a service centre providing guidance to a blind pedestrian who is unable to find their destination. Such a facility could also support remote sign language interpretation.

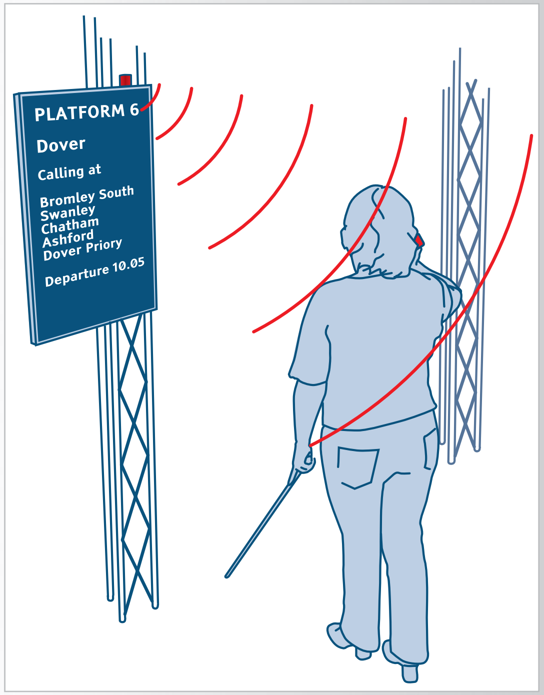
The mobile phone can also permit access to the internet, but the size of the screen is a significant limitation for many partially sighted users.

It is predicted that mobile access to television broadcasts will become increasingly popular as more radio spectrum becomes available for these services. It is not known whether the broadcasters will include subtitles and audio description, and how this would work in practice on a mobile handset.



A person could be guided to a location by a remote service, receiving instructions in audio form.

Wireless Systems



The advantages of wireless systems are that devices, machines and terminals can communicate with each other without the need to be physically connected. This technology is already widely applied to portable electronic devices, including mobile phones, laptop computers, digital cameras and PDAs (Personal Digital Assistants), using technologies such as Bluetooth or WiFi.

Environments can now be monitored using sensors that wirelessly communicate to a control centre. In applications such as smart housing, devices such as door bells, temperature monitoring systems, CCTV cameras, ventilation and safety control systems can be interconnected. Venues such as sports stadiums, entertainment complexes, hotels or conference centres can be designed to take full advantage of wireless systems to not only monitor the environments but also to monitor such things as the movement of people and control of crowds. Combined with RFID technology, wireless systems can significantly improve security.

One of the main devices that use wireless communication are mobile phones. Nearly everyone carries one, and their use in helping people connect to other devices is likely to grow considerably as designers and engineers continue to explore possibilities.

For people with disabilities, wireless systems can provide new ways to guide people, deliver specific information to an assistive device or provide instructions on how to operate a terminal or machine. For example, 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.

Another potential application is to use a wireless enabled mobile phone handset at a sports or entertainment venue. Using their handset, disabled people could indicate that they need more time to pass a barrier, or that they need navigation guidance or information on the event.

At road crossings, a person could indicate that they want to cross the road and need more than the standard time to complete the crossing. They could also receive audio information about road junctions or the destination of trains and buses.

At a cash dispenser or ticket machine, a person with a smart card could instruct the machine to send speech output to a particular mobile phone handset. So the text on the screen of the cash dispenser would be presented as speech. This does not involve a phone call, but just uses the handset which includes a wireless interface, such as Bluetooth.

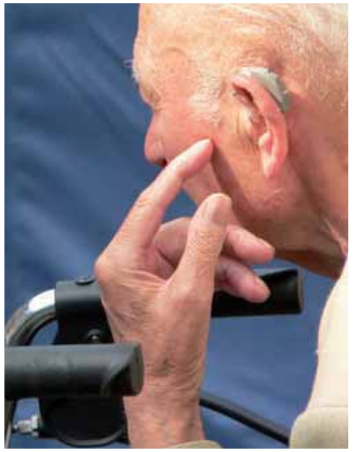
New wireless technology allows hearing aids to be used in both ears rather than just one. This improvement creates possibilities for better audio communication to people with hearing loss. Wireless technology will allow people in museums, galleries, conference centres or venues to receive audio descriptions. Their personal device could request the descriptions in their specific language.

Safety warnings can also be transmitted automatically when a sensor detects a device carried by a person with a disability. This would be particularly important for people with low vision or hearing loss.

To allow elderly people to live or travel more independently wireless technology can make their home, sheltered accommodation or hotel more easy to monitor. As well as monitoring and controlling the environment, messages could be automatically transmitted to warn the actual person or someone responsible for their care. Hotels could use these systems to provide facilities for people who needed extra care or assistance.

Universal Remote Control standards and support services have been developed to promote the use of standard household networking technologies (WiFi, ZigBee and HomePlug, for example) that can provide a means for a low cost and gradual evolution of a standard home, office or venue into an intelligent controllable environment. Further information can be found at www.myurc.com

Wireless systems can help control items in the homes, hotels and venues such as, clocks, thermostats, windows, doors, alarms, ticket machines, and elevators as well as invisible targets like Web services. Remote controllers can include PDAs, cell phones, special watches and other assistive devices.



NFC – Near Field Communication

Near Field Communication (NFC) has evolved from a combination of contactless identification (RFID) and interconnection technologies. It enables a user to exchange all kinds of information simply by bringing two devices close together. For instance, a mobile phone or PDA (Personal Digital Assistant) could act as a ticket on public transport instead of using a contactless smart card.

In order to make two devices communicate, they need to be brought together (within 10cm) or make them touch. This will automatically initiate communication between the two devices. Once configuration data has been exchanged, the devices can then set up longer range communication with faster protocols such as Bluetooth or WiFi.

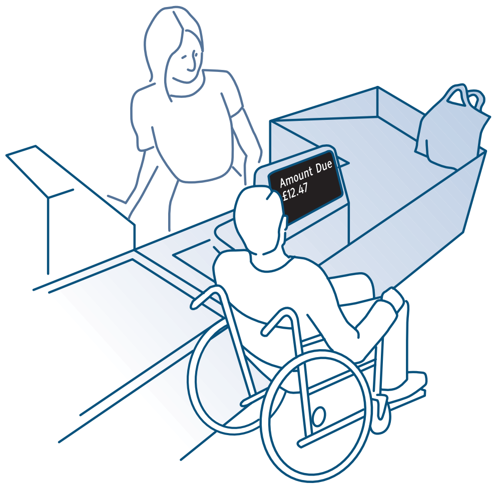
Unlike traditional RFID readers, with NFC you are not scanning for every tag within range. NFC eliminates indiscriminate reading that raises privacy issues, and it also saves battery power. NFC operates at the same frequency as a contactless smart card. When the connection has been made a mobile phone can vibrate to let the user know it has worked.

An important aspect of the design of new NFC devices is that it can allow a person to use a device they are familiar with, such as their mobile phone, to link to a simple interface. This makes the system easy to operate for people who are not good with technology. This can also be very helpful for people with disabilities.

The range of potential applications includes the interconnection of digital cameras, PDAs, set-top boxes, computers and mobile phones. For instance a poster, advertising a concert, could contain a NFC electronic chip. By touching a tag on the poster with a mobile phone, information about the concert could be downloaded to the phone.

Tickets could be directly purchased and stored on a phone handset. On arriving at the venue the user would only have to touch their phone on a reader at the entrance gate.

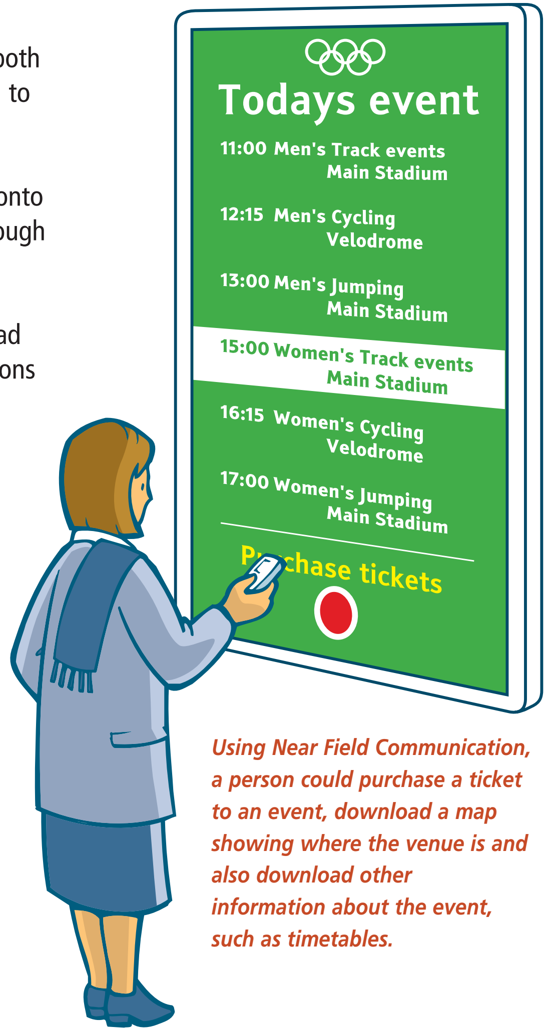
At a bus stop, simply touching their mobile phone on a NFC-enabled sign would automatically allow travel information to be read out using the phone speaker. In general, this technology could make the user interface on many public terminals significantly easier to use by many people with disabilities.



By touching a mobile phone on a poster, as shown below, information about an event can be downloaded. However, users will find it easier if there is a standard icon to indicate where to touch, and if the icon is a consistent height from the ground. It would also be helpful to have standardised feedback to indicate a successful connection, preferably both visual and auditory. A different signal will also be needed to indicate failed or incomplete connection.

Also shown, is how a travel ticket could be downloaded onto a mobile phone. The user would then be able to pass through barriers by touching the phone to an icon at the barriers.

Near Field Communication could also be used to download additional information such as timetables, travel instructions and maps.



Using Near Field Communication, a person could purchase a ticket to an event, download a map showing where the venue is and also download other information about the event, such as timetables.

A person could also purchase a ticket. The payment would be part of their mobile phone bill. The ticket would be downloaded to the phone. NFC would also allow the person to pass through the barrier at both ends of the journey.

Biometric Systems

Biometric systems use biological traits or behavioural characteristics to identify or verify an individual.

Because the other methods people use to identify themselves are variable and can easily be lost, stolen or replicated, biometric systems are being developed to bring tighter security and improve identification. A biometric can be hard to steal or replicate.

Currently, the common biometric systems deal with:

- Facial imaging
- Hand and finger geometry
- Iris or retina pattern
- Handwriting
- Voice recognition
- Vein geometry
- Keystroke

In considering biometrics, it is important to distinguish the difference between 'identifying' who a person is and 'verifying' a person.

Verification

involves confirming or denying an individual's claimed identity - **Is this person the same as the person to whom the card or token was issued?**

Identification

involves checking an individual's identity against a large database - **Who is this person?**

Resolving these questions using biometrics can significantly increase security at airports or at cash machines, help limit the use of stolen items such as mobile phones, stop people obtaining items using a false identity and expose people with multiple or fake identities.

In areas such as security, especially where large numbers of people need to be managed and controlled, biometric systems can not only greatly improve security and access control, they can also improve speed of throughput. Well designed biometric systems should also reduce manpower costs or release security staff to do more important work.

Biometrics are also being developed to help reduce fraud and fake identities on the Internet. If personal data transactions on the web can be more secure using biometrics, this will increase confidence in how information and data is stored and accessed.

One of the advantages of biometric systems is that there is no need for a PIN number or password to be remembered; this would help many people with dyslexia. A mobile phone could be protected by fingerprint recognition; this would benefit those people who are particularly at risk of having their phone stolen.

Hand or finger geometry

Fingerprint systems are working well, in that they have a low number of false acceptances. However, they 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.

Facial recognition

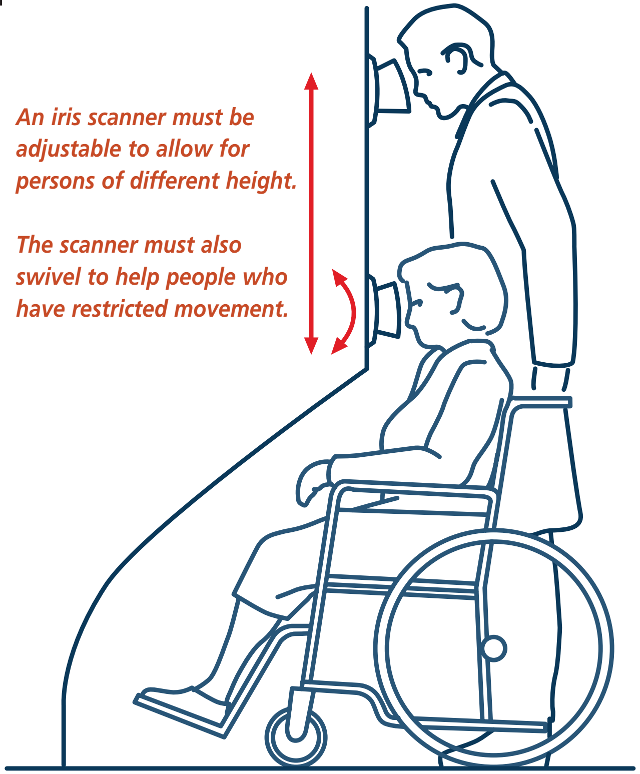
Facial recognition can have an unacceptable level of either false positives or false negatives. It is technically best used to verify a person rather than identify who a person is. Thus it is an appropriate technology when used with a secure token such as a smart card. From the user's perspective it's 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.

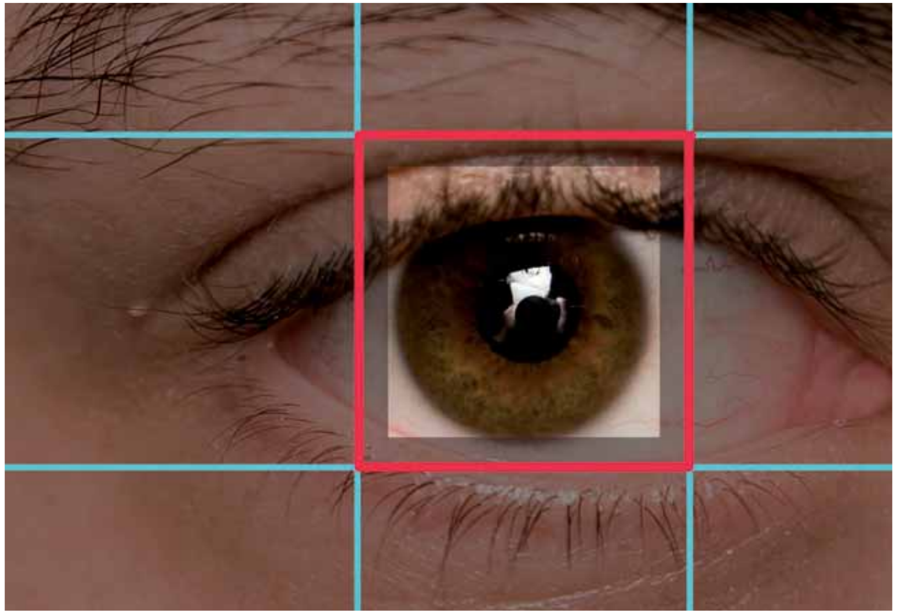
Voice recognition

Voice recognition may not cause many problems for people with disabilities but the reliability of this system can be easily influenced by changes in a voice due to a sore throat or common cold. People who are deaf may speak in ways that are difficult to match.

Iris or retina 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.





Before introducing a biometric system it is important to thoroughly test the system with people with a range of disabilities.

Web Accessibility

For people who are blind or have low vision the World Wide Web has greatly improved their ability to access information and to communicate. This also applies to many people with auditory, physical, speech and cognitive disabilities.

The web is now one of the foremost sources of information, entertainment and interaction for nearly everyone. As a resource it is used for education, employment, government, commerce, health care, recreation, and more. However, many web sites have barriers to accessibility that make it difficult or impossible for many people with disabilities to use.

For people who are travelling or booking tickets, or who want to find information about venues, places or events, the web is often the first place they will access.

Because email is text-based and relatively easy to learn and to use, it has been very useful for many people with disabilities. For a web site to be accessible, a person with a disability must be able to perceive, understand, navigate, interact with, and contribute. This is also very important for older people when their abilities change due to ageing.

Many blind persons rely on screen readers to access the web; these screen readers are software that reads text on the screen and outputs this information to a speech synthesizer or braille display. Some people who are blind use text-based browsers or voice browsers, instead of a graphical browser. They often use rapid navigation techniques such as tabbing through the headings or links on web pages rather than reading every word on the page in sequence.

Some people with low vision use extra-large monitors, and increase the size of the fonts and images. Others use screen magnifiers or screen enhancement software. Some people need to have specific combinations of text and background colours, or choose certain typefaces that are especially legible for their particular visual impairment.

People with colour blindness sometimes need to use their own style sheets to override the font and background colour.

It is possible to design and build web sites that allow all of these systems to be used by a person who is blind or has sight problems.

Many people who are deaf or hard of hearing rely on captions for audio content to access the web. They may need to turn on the captions on an audio file as they browse a page.

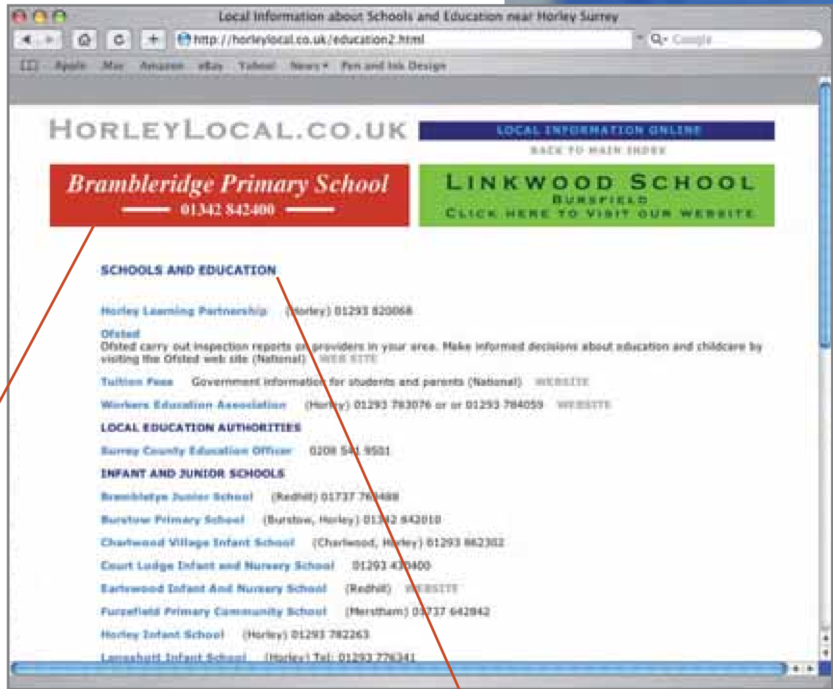
When a person has physical disabilities such as weakness or limitations of muscular control they may use a pointing device such as a head-mouse, head-pointer or mouth-stick. They may use voice-recognition software or other assistive technologies. When designing web sites that allow for this type of disability, a facility to allow more time for response is important. Also forms that can be tabbed through in a logical order will help.

Many website designers work on the philosophy that the user's browser is no more than a year old. In the case of disabled users, it is likely to be considerably older than that, so there can be a problem with legacy systems.

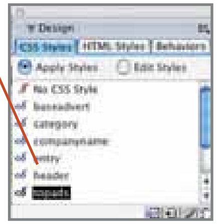
Guidelines have been produced for how to design accessible websites, but these guidelines are widely ignored by commercial organisations. So some websites are accessible, but these tend to be ones belonging to government departments. Many of the popular websites, for buying tickets, shopping and home banking, are still largely inaccessible.

Recommendations for a web site to be accessible include:

- Use the alternative text (alt) attribute to describe the function of images and animations.
- Provide captioning and transcripts of audio, and descriptions of video.
- For hypertext links, use text that makes sense when read out of context.
- For page organisation, use headings, lists and consistent structure. Use cascading style sheets for layout and style where possible.
- Summarise in text the significance of graphs and charts.
- For tables, make line by line reading sensible. Avoid using tables for column layout.
- Use relative sizing instead of fixed (e.g. for fonts, tables).



When 'alt' tags are used on a web page, they provide alternative text that can describe an image or link. This can enable a blind person to receive and audio description and thus helps site navigation.



Web pages built using Cascading Style Sheets (CSS) can control the colour, size and appearance of fonts and graphic elements on screen.

When a web site is being designed it is very important to build in all the accessibility requirements from the start. To retrofit is difficult and costly.

Wayfinding

Traditionally, a blind person has relied on a guide dog or a long cane to navigate the environment. With the introduction of new technologies such as real-time passenger information systems, there are an increasing number of ways to help blind travellers for which the additional cost is not prohibitive.

A typical journey will involve more than one mode of transport. For example, it might involve walking to the bus stop, a bus to the railway station, walking from the bus to the train platform, a train to another town, walking from a train to taxi rank and a taxi to final destination.

Working out the optimum combination may not be a simple task since it may be a function of price, times of public transport and accessibility aspects. At present there is no generally available information service which provides a comprehensive service for journey planning including accessibility aspects.

The environment in which we live is becoming increasingly complex; even a bus journey across a city requires a range of skills including:

- Being able to avoid obstacles on the pavement
- To walk in the right direction
- To safely cross the road
- To know when you have reached a destination (e.g. found the correct bus stop)
- To know which is the right bus
- To pay the correct fare
- To find a vacant seat
- To know when to alight from the bus

These tasks may seem trivial, but for someone with no useful vision they are skills which have to be learnt. Even for someone with low vision, all these tasks are less easy than for someone with normal sight.

Over the last thirty years, engineers have devoted considerable resources to developing electronic systems to help a blind person avoid obstacles; these use technology such as ultrasonics, lasers and infra-red.

Many of the devices just provided information about the range of the nearest object; a 'picture' could be built up by moving the sensor from side to side. Other devices have attempted to give a more complete image of the environment but at the expense of providing an excessive amount of information to the blind user.

The capacities of the senses of hearing and touch are very small compared to that of the visual channel for a human. Selecting and processing the information to make best use of the non-visual channels is not a simple task. The sensors in future devices are likely to involve more than one modality (e.g. both a video camera and an ultrasonic transceiver) in order to obtain the necessary data which can be processed to produce an accurate image of the immediate environment.

For a blind person, the problem of getting about is not just that of not walking into objects. One problem is that of knowing the layout of the environment; here, an embossed map can help. However, embossed maps are not easy to produce or interpret since just embossing a sighted map seldom leads to an intelligible embossed map.

Even with an embossed map and a mobility aid, it is still very easy for a blind person to get lost. A number of electronic orientation aids have been developed, but few have been widely used because of the cost of modifying the environment.

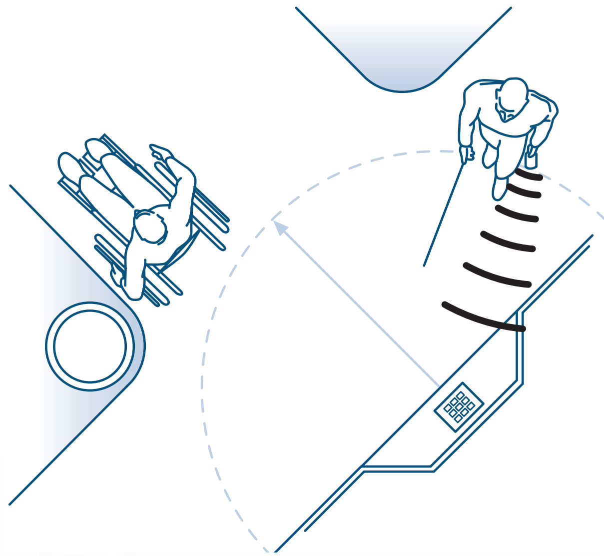
One type of system uses infra-red transmitters mounted at street corners; the infra-red signal is modulated so that a receiver, held by the blind person, gives out an audible message. These systems can also be used to indicate the status of traffic lights. Similar radio-based systems have been used in some countries, and the advent of Bluetooth is likely to dramatically reduce the cost of installing such systems.

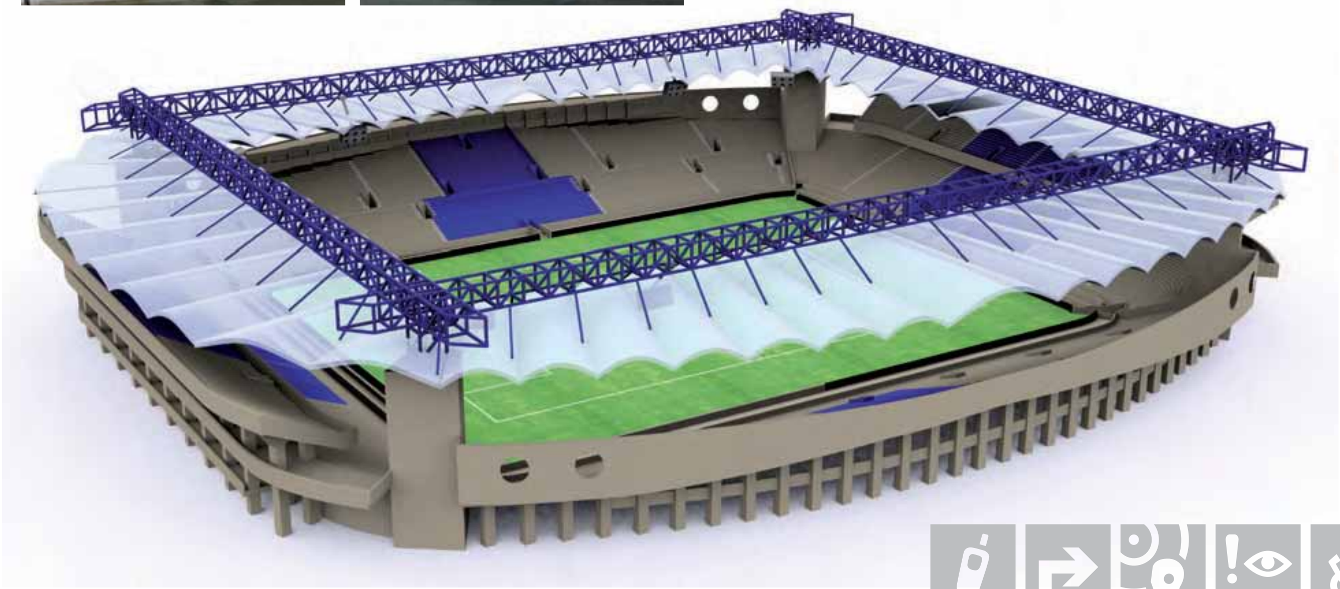
A different concept is for the blind person to carry a tag similar to the ones used in shop security systems. Thus, machines can detect the presence of a blind person within a few metres and modify their behaviour (e.g. give out a speech message). The tag or smart card can be pre-coded, which could indicate that the person would prefer messages in an alternative language.

Satellite navigation systems can be used to determine one's position to a few metres. However, this requires line-of-sight to three or four satellites, which means being outdoors and not close to tall buildings. This position is just given as latitude and longitude, so it needs to be integrated with a detailed digital map of the area.

The availability of sufficiently detailed digital maps has proved to be a significant problem. Digital maps designed for car drivers do not give the detail needed by a blind pedestrian. Ideally the map should not just show the bus stop, but also provide information about which buses stop there.

Numerous wayfinding systems have been proposed, and many have been successfully developed to demonstrate the technical feasibility of the system. However, what is lacking is a clear plan for implementing systems and services so that blind users do not have to cope with different systems in each area.





Location-based Services

Over the next few years there is likely to be a dramatic increase in services for the general public which are based on knowing your location. Satellite navigation in cars is already widely used. A mobile phone handset is another device on which it will be possible to request the location of the nearest bank and be provided with instructions on how to reach it.

The possible scenarios for providing people with specific information at a location, or about their location, could allow a blind person to carry a device which received audible information about where they were, what their surroundings were like and what was available. This person could set their device to only provide information on such things as the route they could take to reach a destination. The complexity of information could vary depending upon the place. A railway station would provide information on ticket machines, platforms and other facilities. A road junction may only provide information on options for crossing the road and which directions a person could take.

It would be possible to place information 'tags' or devices at every important place. These could allow all people to carry a device to pick up the information. Overseas visitors who would like information in their language could use the system.

Another advantage for a blind person or a visitor who did not know their way around, would be an alert that told them that they were travelling in the wrong direction. If they had set their device to help them get to a certain place, the system could interact with them to guide them accurately to their destination.

There are many questions that arise about how to make these scenarios workable. For example, how would the information be kept up to date, especially for problems such as road works or detours on pavements? However, the possibilities to help tourists and provide innovative services mean that location based systems should be developed. The additional potential benefits for people with disabilities and visitors would be of great social value.

Emergency services often need to know the precise location of an incident. A blind user may not be able to describe their position, so the ability to transmit information specifying their location could be invaluable. Ideally, the alarm system that operates in and around their home should also work when they are away from home without the user having to do anything.

There have been a number of trials of stand-alone electronic beacons; commonly these use infra-red or radio to give pre-recorded audio messages for the blind pedestrian. However, the difference between these and the new systems under development is that the new systems will be part of an integrated network. They will use short-range radio technology such as RFID, Bluetooth, WiFi and WiMax.

These short range systems will be used in conjunction with long range systems, such as mobile phones, where the network knows the approximate position of the user. For more accurate positional information, the systems may be supplemented by satellite positioning systems (such as the American GPS, the Russian GLONASS or in the future, the European Galileo system). These systems predominantly rely on line-of-sight to a number of satellites and so have low levels of coverage indoors, and relatively poor position accuracy when used in urban canyons. However, the latest high sensitivity receivers, and a technique known as 'Assisted GPS' will improve indoor coverage and the accuracy and availability in urban canyons.

Information about one's position is of limited use unless it can be related to the real environment. So these systems are usually linked to a database which may include information normally found on a map plus other related information (e.g. the scheduled times of buses from a particular bus stop or the time until the next bus arrives). In addition the database could include accessibility information.

For these systems to be of practical benefit to blind people, they must be:

- Easy to use
- Provide output in an appropriate form (e.g. speech)
- Contain up-to-date information
- Reliable
- Affordable
- Not invade privacy.

Transport Information Systems

In the foreseeable future there are going to be significant changes in real-time passenger information systems, not all of which will be to the advantage of blind and partially sighted travellers. At the same time new technological methods for accessing information could be implemented if the transport providers are convinced that there is sufficient demand for such facilities.

The user often has a choice of methods to reach a specific destination, but there is rarely a single source which can provide information of the times and costs of all the options. One type of system likely to become more common is the automated telephone-based information system which incorporates speech recognition. This allows a blind person to obtain information in audio form in an interactive way. The blind person speaks to the system and gets an audio response: "You have asked for the arrival time of a flight from New York. Please say the flight number." These systems can work well if the caller has a reasonably standard query; however they need to be well designed to avoid confusion.

There is likely to be an increasing amount of information on the web but it may not be in the most accessible or usable format. Timetables are often shown in a complex tabular presentation which is difficult to access with speech output. Another method of accessing such information may be interactive television; as yet, these systems are largely inaccessible to blind and partially sighted people.

There are already unmanned railway stations, and the transport operators will want more customers to purchase tickets from machines. These machines can be difficult or impossible to use if you cannot read the screen. It is possible for a ticket machine to have large characters on the screen or speech output, but it adds to the cost of the terminal.

In places such as shopping centres, car parks, railway and bus stations, locating an information terminal or cash machine can be difficult - particularly for people who are blind or have low vision. For low vision users, signs showing where a terminal is could be large and high contrast (preferably white or yellow characters on a dark background) and illuminated (preferably internally illuminated). 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.

Digitally stored speech can give very good quality audio, but it is effectively limited to pre-stored messages. Full vocabulary synthetic speech is often difficult to understand for naïve users, particularly if they have a hearing impairment.

In some towns, bus stops are fitted with a visual display giving the destination and expected arrival time of the next bus. It would be possible to have speech output from this display; this could be activated by a button or a contactless smart card.

Infra-red systems have been developed which involve a transmitter mounted on the bus stop and the blind person carries a hand-held device which gives out the audible message; the disadvantage of such systems is that they are expensive to install and maintain.

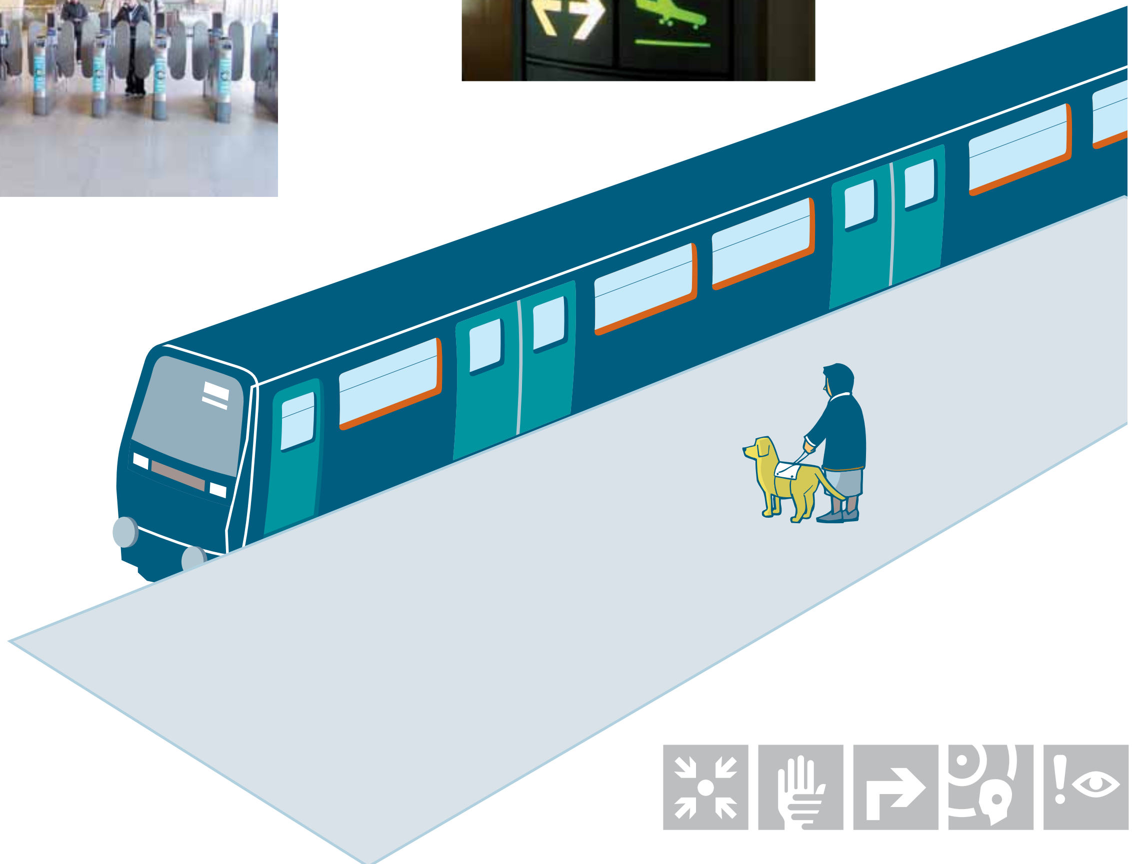
Another method of obtaining speech output from a visual display would be by a short-range radio link, such as Bluetooth, to a mobile phone handset. This use of the mobile phone handset could also apply to screens on platforms at railway stations and transmitters could also be mounted on buses giving their route numbers and destination.

In the last few years improvements have been made to the position, shape and visual contrast of hand rails on buses and trains. However, a problem still exists in the range of different layouts used in various trains and buses. It is not always obvious where is the best location for a guide dog so as not to be trampled by other passengers.

Some trains have a visual display of the name of the next stop and a few have an audible announcement. This is less common in buses, even though the technology is available. In circumstances where public audible announcements may be unsuitable, wireless systems could be employed to make the announcements available to the passengers who want them.

However, there are still aspects which are difficult to resolve technologically. For instance, the bus driver may not be able to stop precisely at the bus stop. In addition, if the bus stops away from the pavement, cyclists may pass between the bus and the kerb.

Blind and partially sighted users are very dependent on the transport system running in a predictable manner according to the timetable. It is when the system is disrupted that the information systems are often inadequate, provide inaccurate or out-of-date information and rarely provide it in a non-visual form. Even then it may be difficult for a visually impaired person to act on this information.

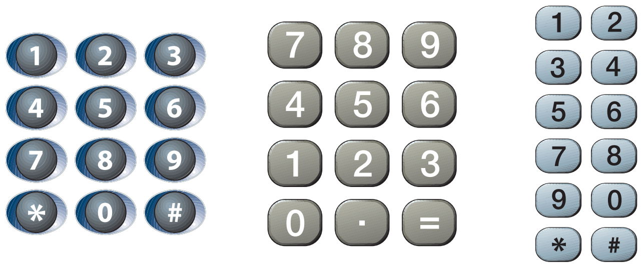


Making the systems available

Getting maximum benefit

To maximise benefit to the visitor, as well as maximising sales and therefore profitably, the technologies described in the previous sections need to be integrated into a coherent system. Without integration, there will be a number of stand-alone services which are less likely to have significant market penetration. Most of the technologies described have been piloted in applications relevant for visitors; the results have generally been that the technology can operate reliably, but the usability could be significantly improved.

For all visitors, particularly those who are blind or partially sighted, a consistent user interface is highly desirable. An example of inconsistency is the different layout of the numeric keys on a calculator and on a telephone. On both of these layouts the number '5' is in the centre of the keys. A raised dot is used to help a blind person identify the number 5. However, adding this raised dot does not help a blind person determine which layout is being used. On a Chip & Pin terminal the location of the function keys can vary from terminal to terminal. It can also be confusing for blind users when on an ATM one just inputs the four-digit personal identification number but on most Chip & Pin terminals it has to be followed by pressing the Enter key.



The need for standardisation

To bring about full and seamless integration, including both technical and user interfaces, will require a high degree of collaboration between all the stakeholders. One possibility would be for there to be a European or international standard defining the requirements in a form which does not inhibit future developments when new technologies become available. For such a standard to become mandatory would probably require a European directive.

The standards need to cover the structure of the content and network, as well as the design of the terminals. Accessibility needs to be considered in all three areas. However, it is not sufficient to just follow accessibility checklists for the various components; accessibility must be evaluated for the integrated system as a whole.

The longer the delay in preparing appropriate standards, particularly those for the user interface, the harder it will be to reach a consensus on the optimum specification. While these standards are being developed, it is essential that they are thoroughly tested with users with a wide range of abilities, especially those with disabilities.

It is important to have a consistent user interface.

Research
Because research and development resources are limited it can be very helpful to know which services and products have proven to be beneficial in other countries even if they have not been adopted elsewhere. There are experts in disability that can guide developers on where to obtain information, standards and examples of good practice.

It can help designers if technology companies provide training in disabilities and user needs, make use of guidelines and specialist information, such as on the Tiresias web site, and establish tests with an appropriate cross-section of potential users.

When considering the needs of people with disabilities, some services might be of enormous benefit to only a small group - perhaps those who are both deaf and blind, whereas others may be of modest benefit to a very large number of users. This type of information should be part of the research.

User-centred design
Involving user representatives early in the product design cycle is referred to as user-centred design. It is important to ask user groups to participate in usability testing before a product or service is ready to go to market. A product or service that does not meet the users' needs is likely to fail in the marketplace.

There are organisations and groups that represent a particular disability. It can be very beneficial for industry to work with these groups, particularly if they ensure that they include a wide spectrum of user needs. Representatives such as these often need guidance from industry on how to be involved in an effective development programme. This should cover areas such as research, design, marketing and standards-writing.

To establish and get the best from a body of user representatives, it is very beneficial to set up training and mentoring programs. These can ensure that user representatives learn more about the technologies involved and the design processes, as well as such aspects as legislative and regulatory frameworks. In addition, skills can be taught such as business procedures, public relations and communication skills, as well as the principles of representing wider group interests rather than just the representatives' own accessibility interests.

Some of this may seem common sense to industry professionals, but people with disabilities can benefit from learning to combine their personal experience of disability with professional skills. When guidance, interaction and feedback take place between industry and representatives of disability interests, better results can be achieved for all concerned.

New services should be compatible and integrated.

Developing new systems

Developing a novel product or service, rather than a new version of an existing product or service, is always a challenge. With the increasing number of people with a visual disability, many of whom will be over retirement age, it is wise to include them as potential consumers. However, for companies with limited experience of working in this area, there are a number of pitfalls which could easily be avoided with appropriate planning.

The development of new products and services has often been led by designers thinking of what could be provided rather than by demand from their customers. This is not a major problem when the designers have a good understanding of the needs and aspirations of the user group, but this is rarely the case when the users are people with disabilities.

Understanding disability

Firstly, it is important to understand the nature of different disabilities and how they restrict and exclude people from doing things. Many disabilities are related to age and many elderly people have more than one disability. The fact that people in Europe are living longer means that a higher percentage of the population will be older and thus will be restricted by disabilities.

In a commercial sense elderly people are a large market. If products and services are designed that are difficult for them to use then a commercial opportunity will be missed.

People of all ages travel more. They visit different countries, events, museums, galleries and shopping centres. Tourism is big business for most countries. Those transport systems, venues, hotels, towns and cities that are easily accessible by people with disabilities will be used and visited by more people. Even without this commercial incentive, for many countries, legislation now requires that environments and services must be made accessible.

Understanding needs

When a new product or service is under development, designers will find that they can create fresh ideas and possibilities if they fully understand the needs of people with disabilities. For example, different impairments can affect individuals differently, and two people who appear to have the same combination of impairments can have very different requirements. A knowledge of how people cope with disabilities and how they affect different people will make a designer more aware of how the inclusion of a feature can really help a product or service become so much easier to use.

Too often designers work with simplistic concepts of disability. They may think that visually impaired people are totally blind, read Braille and have better hearing. Prototypes are often tested on a very small number of unrepresentative users, leading to products or services that fail to meet needs or become uncommercial.

The first picture shows how a person with normal vision would see a telephone. The second picture shows how someone with macular degeneration might see it.

The complete system should be evaluated for accessibility.

Field testing
Although laboratory testing with a small group of users can provide useful information, it is recommended that there should also be field testing using a combination of observation and interviews that reflect the real experiences of the end-user. In these processes it is important that potential consumers have realistic expectations of the benefits of new services, even if they are not directly paying for the service.

Marketing
Marketing to people with a disability can present particular challenges since the normal marketing techniques may be inappropriate. For example, the way blind customers gather information is very different from the way people with good sight read advertisements and leaflets.

Another factor to consider is that most people with disabilities are reluctant to use a product if it looks like it has been designed for 'the disabled'. Many consumers, particularly those who are ageing, do not like to consider themselves 'disabled'. Careful consideration needs to be given when promoting products or services to specialist groups.

Most companies have not developed appropriate marketing strategies for potential customers with disabilities. This failure may have led them to believe that there is little potential demand. If businesses wish to broaden their customer base they can miss a valuable opportunity by not studying the needs of a particular group.

Training and support
Customers with disabilities will often need more support than that provided to non-disabled customers. For instance, people with low vision may not be able to read the instructions for setting up and using equipment. It may be necessary to provide the instruction books in alternative formats (e.g. braille, large print and audio) or at least digitally, so that they can easily be converted into formats offering speech output.

A particular problem can be when a product or service malfunctions, since it may not be easy for the user with a disability to ascertain where the fault is located or to run diagnostics, even with help over the telephone. Therefore consideration needs to be given to providing appropriate support services.

Legislative requirements
When the market does not deliver the required results, or services and environments are not inclusive, national regulators may step in with mandatory requirements. Some countries have discrimination legislation such as the Disability Discrimination Act in the UK.

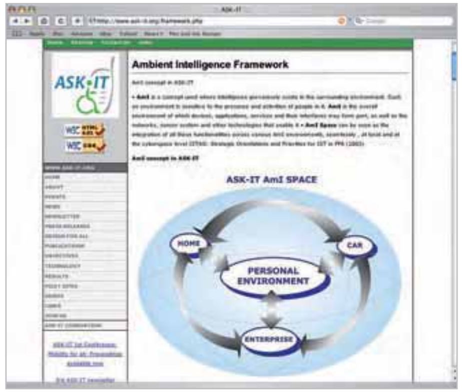
Conclusion
The technologies described in this booklet offer the possibility of making life easier for many people with disabilities. It is up to government departments, standards organisations, commercial companies and user organisations to work together to ensure that people with disabilities benefit from these technological developments.

Good design for people with disabilities is frequently good design for everyone.

Further Information

ASK-IT

The ASK-IT project aims to support and promote the free movement and independence of people with special needs. With a primary focus on providing travel information, the customer will also be able to access information relevant to home, work and leisure activities. Information can be accessed through a combination of telecommunications services and other information and communication technologies.
www.tiresias.org/ask-it/ask-it.htm
www.ask-it.org



Happy Tourist

The Happy Tourist project aims to offer equal opportunities to people with disabilities, either as tourists or staff, based upon the combination of innovative, modular and cost-effective information and communication technology tools, e-learning concepts and on-the-job-training schemes.
www.tiresias.org/guidelines/accessible_tourism
vodafone.lst.tfo.upm.es/happy_tourist/

RNIB Scientific Research Unit

The Unit is a partner in both ASK-IT and Happy Tourist projects which are funded by the European Commission.

The web site www. tiresias.org also contains a wide range of useful information on how information and communication technologies can be used to help people with disabilities. This web site also has specific guidelines on subjects such as the design of public access terminals, the use of suitable typefaces, mobile telecommunications, smart cards and biometric systems.

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Many of today's technologies could offer significant benefits to disabled visitors

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Olympics