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A review of user-interface design guidelines for public information kiosk systems†

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This paper reviews general guidelines on user-interface design for self-service and public information kiosk systems, based on the author's research and on existing literature. The guidelines cover such topics as: defining user requirements, location and encouraging use, physical access, introduction and instructions, language selection, privacy, help, input, output, structure and navigation, and customization. The paper also emphasizes the need to design for stakeholders other than the end users, and offers some guidelines on user-based evaluation of kiosk systems.

1. Introduction

There is a continuing trend to develop terminals, accessible in public locations, to deliver information and services to the general public. These terminals, or kiosks, can deliver services at the point of need (e.g. money near a shopping centre, tickets in a station), and at low cost. The information contained within a stand-alone kiosk can be updated at regular intervals via CD-ROM. If the kiosks are networked, information can be transmitted electronically to many sites rapidly to update the database or provide on-line user access.

Successful early systems developed for special events were the Exhibition Information System at Expo'92 in Seville and the 1984 Olympic Message System (Gould, Boies, Levy, Richards & Schoonard, 1987). The CHI'89 conference system in Austin, TX (Salomon, 1995) contained multimedia data about the city of Austin, the conference program, and allowed participants to record personal information and enter a digital photograph of themselves (a major factor in its success). Other systems are tailored specifically to meet the needs of the local community such as those developed under the United States Congressional Office of Technology Assessment (OTA) initiative to offer government services through multimedia public access kiosks (Peltu, 1994). These range from advice on people's eligibility for welfare benefits, to health and environmental information.

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Similarly the EU Telematics Applications Programme has funded projects to develop kiosks to supply tourist, transport and local government information across Europe. These include the ATTACH project UR 1001 (Advanced TransEuropean Telematics Applications for Community Help) and the PD WEB project UR 1021 (The Public Data Web). A recent development in the UK is British Telecom's network of Touchpoint terminals (Carpenter, 1997). These provide news, weather, street maps, restaurant guides, sport, music and financial information to the public. The terminals also offer services which can be purchased, such as ordering theatre tickets or flowers.

Local councils and government departments are now also offering information and services to the public via kiosks. This is in line with the UK government's commitment to providing public access to government information via electronic media. Potential services include driving licence renewal, tax calculation and perhaps payment, and support for making grant and benefit applications. The Employment Service (Bassett, 1997) is offering one such facility to the public. Here employment seekers visiting a jobcentre can search for suitable work via touch-screen kiosks. Users specify their job choices and receive information about relevant vacancies. In some cases they can make telephone calls to prospective employers immediately using a telephone connected to the terminal.

Kiosk systems present a challenge to designers if they are to be used effectively. First a kiosk systems has to be noticed by passers-by and the purpose of the system must be clear. Kiosk users will often be accessing the system for the first time. They may have been given introductory information on it beforehand, but the system must also appear simple and intuitive if they are to start using it. The general public will include people with very different levels of skill, experience and confidence in using interactive computer-based systems. Therefore to be inclusive, kiosks must be designed to cater for those with limited skills or experience, or with physical and cognitive impairments, and should be supportive towards those who are inhibited in interacting with them in a public area. Systems are normally designed to be used on a causal "walk up and use" basis. This also means that kiosk systems should be as self-explanatory as possible. Users may have little time in which to use the system, so it must be capable of producing information or services quickly. Finally, if a user becomes confused they will not necessarily feel impelled to continue with the interaction. Thus, the system must be understandable at all stages of the interaction process, and return automatically to its initial state if it becomes abandoned.

This paper presents guidelines on the human aspects of kiosk system design, drawn from the literature and the author's own experience of research into such systems. However, this is an area which is growing fast with new applications. Further research and user experience from these applications will lead to improved and refined guidelines in the future.

2. Defining the user requirements for the kiosk

An important first step is to define the purpose of the kiosk, the user population whom it is intended to serve, and their task goals. Such a user-centred process (Eason, 1981; Taylor, 1990; Catterall, 1991; Nielsen, 1993; Daly-Jones, Bevan & Thomas, 1997) is needed to ensure that the kiosk meets a genuine need and that people will be motivated

to use it. It is also necessary to consider typical task scenarios (Clark, 1991) defining specific examples of people using the kiosk. These should reflect the different tasks, variations in tasks, possible problems that users might face (e.g. being short of time, not having certain information to complete the task, etc.) so that the kiosk can be designed accordingly. It is important to understand the characteristics of the user population and the kinds of environment (physical and organizational) where the system will be located, so that the design can reflect them. Design guidelines to meet these contextual characteristics are discussed later in this paper, and recommendations are included to cater for peoples' different levels of experience, confidence and ability. Discussion groups, interviews and user-based tests should also be carried out to get user reactions to the concept behind the kiosk and to test prototype versions of it at different stages of the development process.

3. Location and encouraging use

3.1. LOCATION

Kiosk systems often rely on being noticed by the public passing by, who decide on the spot whether to make use of them. However, usage is likely to be much higher if the system has been advertised beforehand either in the local newspapers, through the post, or in the window of an information or service centre. Having become established in peoples' minds beforehand, they are then more likely to try out the system when they see it. People are also more likely to seek it out, if they perceive it as useful.

Within the vicinity of the kiosk, it may be necessary to provide signposting to its specific location. For instance, a public information system within local government offices, or a multimedia system in a museum (such as the London National Gallery's 'Micro Gallery'), will need directions for finding it. If a system is placed in a secluded area to give the user some privacy, this will also need to be well signed in order that people do not pass by without noticing it.

In an evaluation report of the PD Web public information system, based in a local library, the following suggestions for system location reflect some of the issues (Maguire, 1997):

> "Should be placed in the middle of the floor, near entrance so it's not associated with any dept of the library."
> "Could be missed where it is. Needs a more prominent location."
> "At the entrance but not in line of people entering."
> "Infront of you when you enter."
> "At wall opposite main entrance, not at pillar in middle."

In general, the system should be placed logically within the flow of peoples' movements and at the point of need (May, 1993). This will help the kiosk to be noticed and used. Poor positioning will have the opposite effect. For instance, if a ticket terminal is placed on a station platform beyond the manned ticket desk, then people will fail to see it before buying a ticket at the desk.

For users with low vision, Gill (1997) recommends that kiosk signs should be large and of high contrast (preferably white or yellow characters on a dark background) and

illuminated (preferably internally). Gill also recommends that if a blind or visually impaired person is not familiar with the environment, they will find it difficult to locate the kiosk or terminal. One way of dealing with this is to use a 'contactless smart card', carried by the visually impaired person, which then triggers an audible signal from the terminal when they are a few metres away from it.

3.2. ENCOURAGING USE

A self-running demonstration is a good way to encourage users to approach the system and to find out what it can provide. Such demonstrations should be bright and eye catching, presenting short phases about what is on offer and typical screens. It should also be clear that the demonstration can be interrupted to start using it and indicate clearly how this can be done.

As causal users decide if the system is usable or not, one of the criteria to take into account is the *look* of the system such as general clarity, familiarity, attractive appearance, etc. The design of the screen content (colour, form and placing) was tested by Daniel and Krueger (1993) as part of an experiment. Four different layouts were developed to find which was most appealing and easiest to understand. The screen content (number of buttons and fields, contents and naming of these) was identical, and only the representation of the elements (form, placing and colouring) was varied. The four basic design approaches were as follows.

(1) Used white and grey as dominant colours with colour added for help, break and confirm buttons and the selection of dialogue languages (flags).
(2) Used pseudo-3D elements similar to those used on an advanced "Windows" user-interface. Shades of grey were dominant, adding colour to the main selectable buttons and languages (flags).
(3) Used similar colours as (2) but added no form of 3D. All colours pastel.
(4) Used saturated and bright colours, with added three-dimensional shading for the buttons.

Interestingly, it was found that design (4) was preferred, characterized by subjects as playful, lively and motivating to use. It was rated best by people both over and under 40-year old with younger people having a greater preference for the design than older. The reason could be that for a public system, easy recognition of function, or the clear meaning of colour codes is important and a certain degree of motivating colour is preferred. Testing of the complete system confirmed the earlier findings and people commented favourably on the use of colour and function representation. However, colour should be used with care. See guidelines presented in Section 10.3.

4. Physical access

The height of a kiosk has to be set so that it is convenient for both standing users and wheelchair users to access the keyboard. Wheelchair users may have to line themselves up alongside the kiosk and twist around to use it. However, if there is a recess underneath the terminal, the user's wheelchair can be brought closer and face the terminal, making it much easier to use. As recommended by Gill (1997), for wheelchair use, the maximum

TABLE 1

Screen height (m)	Angle from vertical (deg)
Up 0.9	60–90
0.9–1.1	30–60
1.1–1.3	0–30

height of any interactive element on the kiosk system should not exceed 1.2 m. The lowest height of any operable part of the user interface should not be less than 0.7 m. Gill provides some recommendations for screen height and angle so that the display is viewable from a wheelchair as well as for a standing user (Table 1).

People with low vision should also not be prevented from getting their faces close to the screen. In order for a person in a wheelchair to access the kiosk easily, there should be a clear area of 1.5 m radius around the terminal which should not be obstructed by litter bins or other street furniture (Gill, 1997). A well-lit card entry slot, which is also funnel shaped to guide the card, can also be helpful.

The problem of glare on the kiosk screen is well known to most users and sunlight can degrade the visibility of displays for all users. Careful location of a kiosk and the use of shielding from sunlight and other light sources will help to address this problem.

5. Introduction and instructions for using the system

Off-line material such as a poster or leaflet is a useful way of indicating what the system provides, the main facilities available and simple step-by-step instructions on how to use it. An effective technique is to make the poster similar to the leaflet so that if all leaflets are taken away, there is at least some fixed equivalent for users to refer to. While instructions are best presented at appropriate places on the system, some people will appreciate being able to refer to an instruction card and are more comfortable with this static medium which they can refer to in a flexible manner. Large print versions of the printed instructions should also be produced for those with visual impairments.

Users will not have the time or inclination to read lengthy instructions displayed on screen before using a system. Therefore, the instructions should be short and presented at each stage of the interaction. If possible, graphical representations of parts of the interface should be included in the instructions to help the user understand them more easily. For example, the instructions: "Use the arrow keys to make a selection and then press OK" could include graphical representations of the keys themselves.

A good way of introducing users to the system is to present a free running demonstration, possibly with simulated interactions. This technique has been adopted successfully within games machines. A demonstration can show users what the system is about, what to expect when they start to use it and how to interact with it. However, such demonstrations should be short enough to be viewed by the interested user and allow them to start interacting with it before their interest diminishes. It should also be made clear that the

user can interrupt the demonstration and how to do this (e.g. with a prominent key labelled 'start').

6. Language selection

Where languages other than the primary language are widely spoken in the local community, or where the system will be used by foreign tourists, it is desirable to provide multilingual interfaces to the system (including instruction cards). This of course requires much additional effort and resources which may or may not be available.

In order to choose the language on the system, instructions can be given in each language to select the appropriate option "e.g. Press here to select English", "Poussez ici pour Francais". Alternatively, a widely used method is to display a series of national flag symbols for each language (although nationals of countries such as Austria and Ireland may object to the use of the flag of another country). The user then touches the flag symbol they require on screen, or presses the associated key, to access the system interface in the language of their choice. This should be the first action that the user performs.

If it is not possible to present all the information in different languages, then the most critical information only could be translated (e.g. instructions to use the system and the most important parts of the content). However, for a system located in an information centre with multilingual staff, it may be preferable to provide human support for foreign language speakers, possibly acting as intermediary users to the system.

7. Privacy

Users will normally prefer to use a system in public without being observed by others too closely. A study was carried out recently by the EC Telematics PD Web project, to evaluate a kiosk designed to offer tourist information, and information on local government and employment opportunities (Maguire, 1997). It was found that the need for privacy depended a great deal on the kind of information being sought. Typical responses to the question about whether users wanted more privacy were the following.

> "If I was looking for personal information may be a bit more privacy is needed."
> "Privacy is preferred for pursuing queries relating to social welfare or low income."
> "Some information (employment) is more sensitive that tourist information."
> "Privacy is required if seeking job information."
> "I would not like a line of people forming queue behind when using the system."

The idea of putting the terminal into a booth was proposed by some users to provide privacy when looking up sensitive information. However, it was also felt that an enclosed kiosk would deter people from using it. In general, the kiosk should be located to one side of a thoroughfare where users, especially the elderly, can operate it without being too immersed in the general flow of people passing by. As recommended by Höynä, Jönsson, Lorentzon and Fasen (1995), for elderly people, it is important that the machine (or kiosk) is in a place where they feel at ease and secure. They may need more time and restarts in using the system if their first attempts fail.

For some systems such as a bank machine, where users are entering personal and financial details, it is essential that they can work privately. Thus, the kiosk should be designed so that the user's body will conceal their interactions from others. A common solution is to place the screen and keyboard at about waist level (for a system to be used standing up) and recessed into a wall. However, for people in wheelchairs, bank machines placed at this height are not always convenient as others can see over their heads. Thus, seated versions of a system may need to be made available if wheelchair users are to use them comfortably (see also Section 4 on physical access).

Users will not wish to draw attention to themselves when interacting with a system, and so any use of sound should be at a very low level, e.g. a low auditory tone to indicate the pressing of buttons. (See also Section 10.8 on speech output.)

8. Help

It is useful to provide help information throughout the system. However casual users, such as members of the public, will not normally have time to search through a help system. They will also not want a list of topics or commands, but will simply want to know how to carry out or complete a particular task (Elkerton, 1988). It is therefore preferable to review each part of the system and decide what help may be needed at each stage, so that it is context related. It should be accessible with a single press of a button, labelled "help", or with a question mark ("?"). This may also be coloured red to make it stand out. As with general system instructions, help information should be concise so that it can be read quickly. If however it is necessary for it to cover more than one screen, it should be clear to the user how to move between screens within the help facility and how to exit from them (or dismiss the help window). This should be achievable, at any time, with a single key press or command (Cavero, Concejero & Gili, 1995).

9. Input to the system

To cater for the different levels of experience that the general public have with interactive systems, it is important that little or no prior experience on behalf of the user is assumed. The prompt for input should explain clearly the form of input required, and which keys should be used to make it.

9.1. GENERAL RECOMMENDATIONS

In general, user inputs to a kiosk system should be as simple as possible. The user should only be required to make one input at a time, either selecting an option on screen, typing in a short text string, or highlighting a menu option and confirming the selection (perhaps by pressing an "Enter" or "OK" key). If the user is required to make a sequence of inputs, it is recommended that each item is presented with a prompt, one at a time, rather than adopting a form-filling style of input. The nature of the input used should be as consistent as possible throughout the task. If the user is required to change to a different input device during the interaction (e.g. moving from a keypad to a roller-ball) this must be highlighted with a clear instruction at that point (May, 1993).

If the user is entering a number or text string into a field, it is necessary to ensure that the input position or focus on the screen is clearly highlighted e.g. with a flashing cursor. It is also important that the inputted characters are clearly distinguished from the system prompt by colour, font, case or inverse video. The input may also be framed within an input box. The user should also have a means of changing or correcting any input errors. A "go back" or "back" option may be needed to enable the user to return to previous inputs and re-enter them if required. To make corrections to a text string, a backspace key (labelled "backspace" or "delete") should be available. Alternatively, if each input is just a few characters, then a simple "clear" option may be useful to clear the whole input field.

9.2. TOUCH SCREENS

Touch screens provide a flexible way of presenting a limited range of commands (keys or touch areas) specific to individual screens in the dialogue. For each screen display, the relevant input buttons only need be shown on the screen, thus simplifying the interface. However, there is a benefit in providing at least some common functions across screens and in fixed positions, e.g. "OK", "Back", "Help", etc.

A certain level of skill is required to use touch screens and users can either find the screen buttons too sensitive or not sufficiently responsive. Some systems only accept an input when the finger is lifted from the screen. Thus, it may be necessary to explain this on the opening screen, e.g. "touch the screen cleanly and lightly", and "the button is only selected when the finger is raised". The 'lift-off' strategy (providing continuous feedback via the screen cursor until the user lifts their finger to confirms selection) is recommended for accurate selection on a touch screen (Potter *et al*., 1998). Problems can occur with the active part of the touch screen seeming out of line with the on-screen button since the user's line of sight is often not perpendicular to the screen. Adjustment of the touch area relative to the button may be needed so that the two are centred along the user's line of sight (May, 1993).

Brief feedback to show that a screen button has been pressed is helpful. This can be either an auditory tone, change of colour, inverse video or a 3D pressed-in effect. To overcome imprecise pointing, each touch screen target must be no less than 2.6 cm^2 (Clarke *et al*., 1996) and preferably larger. It is important that the touch areas or screen buttons are easily distinguishable from other graphics. Prolonged use of a touch screen can cause arm fatigue so for comfort it should be tilted 30 to 45 degrees from the vertical (Sears, 1991).

Several years ago, the public in the UK were less familiar with the concept of touch screens and were less confident in using them compared with a keyboard. Now users are more familiar with them. In the PD Web study mentioned previously (Maguire, 1997), 38 users were asked to rate how easy they found the use of screen buttons. As the results in Table 2 show, the large majority found them either "easy", or "very easy" to use.

Finally, screens can become dirty with constant touching. A mechanism should be set up where screens are cleaned regularly.

TABLE 2

Ease of use of buttons and commands				
Very easy	Easy	Neutral	Difficult	Very difficult
23	11	2	2	0

9.3. KEYBOARDS AND KEYPADS

If a physical keyboard is used, it is preferable for this to be a customized keypad with large clear keys and suitable key labels (for readability to be at least 4 mm in height). All keys or buttons should be tactually discernable. Therefore, standard keys with definite "travel" are preferred and should be raised by a minimum of 2 mm, while key edges should be at least 2.5 mm apart. If, however, a membrane covered keyboard is required, it should have some form of tactile and auditory feedback to indicate when a key has been pressed. It is possible to implement a soft QWERTY keyboard on a touch screen. However this should be a simplified keyboard including, for example, just the letters, digits, delete and enter. It should provide good visual feedback when a key is pressed.

On a numeric keypad, there should be a raised dot on the number 5 key in the centre of the keypad to help visually impaired people.

Many people with visual impairments can use self-service kiosks by learning the layout of the keyboard and of the function keys (Höyna *et al.*, 1995). However, the location of the function keys is not standardized. They should be clearly separated from the number keys, should have good tactile markings and provide good tactile feedback. A low-volume tone or beep may be used to indicate each keypress, although for lengthy inputs, this can be annoying to the user.

For some public systems implemented on a standard PC, there are insufficient resources for a customized keypad, and so a standard full keyboard must be used. This is satisfactory, provided the range of keys that the user needs is constrained. For example, the system should not require the user to press the shift key. Inputs should be limited to, for example, the alphabetic keys, numeric keys, arrows (e.g. for menu selection), delete or backspace, space bar. Other keys should be covered or replaced with blank key caps to simplify the keyboard's appearance. If keys with other labels (e.g. print, help) are required, but are not available on the keyboard, then customized labels may be affixed to the keys provided they are hard wearing and cannot easily be removed. In general, autorepeat for character keys should be suppressed, as users may hold down a key for too long and have to correct repeated characters. However, if the user is moving a cursor on screen with arrow keys, then autorepeat is useful, provided it is not too sensitive and difficult to control.

Members of the public will vary in their typing skills and ability to spell. Therefore try to avoid requiring long textual inputs to the system. Consider possible means to short cut the need for full text entry. For example, if the user is required to enter the name of their local district, ask them to just type the first 2 or 3 letters and then present them with a short list of possible names for them to choose from. If the user is required to enter their

name and address, it is often possible to retrieve this information from national databases, by entering just two items from the following: name, ... postcode, street name and number. Once the full details are displayed, the user should also be given the chance to change them if they are incorrect or out of date.

9.4. SPEECH INPUT

Speech input is rarely used on a public kiosk. However, the increase in the reliability of speaker independent speech recognition systems now makes it a possibility if a limited vocabulary of phonetically distinguishable words are used (e.g. 12 or less). For a kiosk, a telephone handset is perhaps the most practical input device as it is familiar and helps to shut out external noise. The main problem is that pronunciation and speech intonation vary between people, and when speaking, people tend to run words together. Speech systems work best when the user is familiar with them and can speak words distinctly without raising their voice in irritation if they need to repeat an input. Speech input to a public system is subject to problems of: reduced privacy, making users feel less secure, possibly causing embarrassment and being hampered by noise pollution. Gagnoulet (1989) describes a public phone booth equipped with a handsfree voice dialler developed by the research division of France Telecom. This system demonstrated the problems of public access; the recognition rate fell from 92% in the lab, to 75% in the field due to technical problems of noise and speaker independence, as well as the speaker's failure to follow directions (e.g. using non-vocabulary words). Despite these limitations, speech interfaces can offer important benefits to users with visual impairments, and in a commercial focus group study, carried out by the author in 1997, a small sample of visually impaired users were very positive about the concept of a speech-based bank machine.

If users are required to make inputs by hearing a menu of options and selecting one, the number of options should be limited to 4 or 5 to avoid overloading the short-term memory (Bruce, 1990; Schumacher, Hardzinski & Schwartz, 1995). In choosing the wording for prompts, a "goal-action" sequence (e.g. "To do *x*, say *y*") should be used, rather than an "action-goal" sequence (e.g. "Say *y* to do *x*"). Simple, explicit, concise language should be used, rather than technical jargon. The passive voice, negative conditionals and double negatives should be avoided (Schumacher *et al*., 1995). It is important that the interface is designed so that the system is only trying to match inputs with the subset of the vocabulary which is valid at that particular point in the dialogue (Jones *et al*., 1989).

"Word-spotting" (where key words embedded in extraneous speech can be recognized) and "barge-in" (where the user is permitted to speak during instructional prompts) are two techniques, based on natural language conventions, which can improve the speech dialogue (Brems, Rabin & Waggett, 1995). The latter is perhaps more useful for *regular* users of a public system. Robbe, Carbonell and Dauchy (1997) found that users will accept linguistic constraints during speech input, provided the resulting language is a subset of Natural Language. They also found that a short period of training or practice is useful for beginners. However this may only be possible for kiosk systems designed for users who intend to access the system regularly and where a training session will be worthwhile.

9.5. OTHER INPUT DEVICES

The mouse is now a familiar input device to many people, but it can take a little time for novice users to become competent with it. Also a mouse can easily be detached and stolen from a public system. However in locations where users are supervised, such as Internet access in a public library, this will be less of a problem. If a pointing device is required and a touch screen is not available, then a trackerball may be preferred to a mouse because this can be fixed to the kiosk or onto a table. Trackerballs are however less suitable for wide area movement across a screen.

The input device for a public system in the open air has to be robust to sustain continued use and possibly attempted vandalism. Therefore, keys should be constructed of metal or heavy duty plastic. Inside a building, where interaction may be monitored, a kiosk need only have input devices similar in quality to those used in an office.

10. Output from the system

10.1. TEXT

The presentation of information on a display should be kept as clear and simple as possible. Text should be no smaller than 16 point (preferably larger) so that it can be more easily read by members of the public with visual impairments (Gill, 1997). Simple font styles should be used, preferably without (sans) serif. The Royal National Institute for the Blind (RNIB) in the UK has developed a special, easy to read, sans serif typeface called "Tiresias Screenfont" for use on TV screens (see: http://www.eyecue.co.uk/tiresias). A font with a serif may be used for user inputs to help distinguish them from system text. Serif fonts should not be used with small typefaces. Unusual fonts, script and other highly stylised fonts (e.g. shadow, calligraphy) should be avoided. Fonts should be available in a range of sizes, in order to avoid the scaling of bitmap text when very large characters are required (Clarke *et al*., 1996). The contrast between the text and symbols, and the background, should be high whether it is dark text on a light background or light text on a dark background.

10.2. USE OF LANGUAGE

Check that the language used by the system are meaningful to the general public. Care is required to avoid the use of computer terms which may not be understood (e.g. "files", "directories", "server", "spooling", etc.). Another area is the use of technical terms related to the application itself, but which the user may be unfamiliar with. For example, "distance learning" may be used to describe home learning but may not be understood. While it is appropriate to use such terms when they are commonly used in the application area, it may be necessary to provide an explanation of them on a help page.

10.3. COLOUR

Colourful displays can be attractive to members of the public. However, the use of too many colours can produce a confusing display. The number of colour codes should be kept within reasonable limits (4 or 5) if the user is to identify particular elements easily,

e.g. symbols or areas on a map. Of course, with multimedia displays incorporating diagrams and images, the system may use 256 or thousands of colours. Here significant components of the display, e.g. buttons, input fields or icons should be made to stand out by putting distinctive borders around them or placing them within a plain area of the screen.

The following guidelines are also proposed in relation to colour.

- Total colour blindness is rare, but problems in discriminating red and green are not uncommon and are suffered by over 6% of the male population (Gill, 1997), so try to avoid relying on users being able to distinguish these colours.
- Large adjacent areas of red and blue should be avoided as users have difficulty focusing on these colours at the same time, causing visual fatigue (Helander, 1987).
- Use colour to structure the display and group categories of data, and to help identification of interface elements (labels, entry fields, prompts).
- Use colour as an additional cue to help users recognize graphic symbols (RACE, 1992).
- If text is to be used, it should not be colour-coded. Similarly text associated with graphical symbols should not be coloured (Clarke *et al*., 1996).
- Coloured text is preferable for short or temporary interface elements such as menu choices or messages. For permanent elements and long lines of text, use a neutral colour such as black or white.
- Use a pale, dark or neutral colour for the display background.
- Start by designing the display in monochrome. Then add colour, maintaining consistency in use. Test with users to ensure the resulting display does not create unexpected effects (RACE, 1992).

10.4. ICONS

Icons provide a means of presenting commands or information elements in an easily recognizable form, and can be understandable to speakers of different languages. However, for a kiosk system, icons must be understandable without too much explanation, and distinguishable from other icons on the screen. Simple icons are preferable to complex digitized images—e.g. a simple bank note icon has been found to be more readable than the image of a real banknote (Noirhomme-Fraiture & Vanderdonckt, 1993).

It is important to test any icons used by the system to check that they are clearly understandable. It is however very difficult to design icons that are self-explanatory to all users. One solution is to place the meanings of icons within the system introduction, on a help page, or as short labels under the symbols themselves. Icons often work better when used to enhance text-based commands, e.g. arrows for "previous screen" or "next screen", a tick and a cross for "confirm" and "cancel", a printer for "print details". If icons are well designed, then, having been informed of their meaning, a user will be able to memorize them more easily.

In designing icons, take account of conventions that exist such as arrows to move forward or back between screens (as on a hi-fi or video recorder), a telephone symbol to make a call and a magnifying glass to zoom into and out of a display. However, beware of symbols which are used within computer packages but which may not be known to non-computer users.

The "home" symbol to go to a top-level display, for instance, is becoming well known to Internet users but may be unfamiliar to others without explanation.

10.5. FEEDBACK

If the system response to user input takes more than 2 or 3 s, users may start to feel that a fault has occurred. Some form of indication should therefore be provided that the response is in progress. This may be a simple 'please wait' message or, for responses of, say 10 s or more, a progress bar to show how long the wait will be. If the result of the interaction is printed output, again some indication of this (e.g. "printing now") and possible the length of the delay (e.g. "this will take about 30 s") will be helpful for the uninitiated user.

10.6. IMAGES

Photographs show a detailed portrayal of reality, in contrast to graphics which simplify complex information or emphasize essentials. Photographs or images should be used to represent factual and documentary information where it is required to reproduce things as close to reality as possible. Colour can make an image appear more lively and so is useful for, say, people or landscapes. Black and white images are suitable for showing a concept or theme in general terms, or to ensure that an image does not distract the user too much from the text. Simplifying or emphasizing certain details of an image requires certain graphic design skills. (Vossen, Maguire, Graham & Heim, 1997).

An image is a good way to supplement text; for example, a multimedia holiday system may present pictures of hotels, famous buildings, local dishes, etc. By seeing the images (closely representing the real object) as well as the textual descriptions, the user can quickly locate the item of information they are interested in. As with text, presenting too many pictures can reduce their impact. One of the main errors in using images is to take an image designed for use on a large scale (say on a brochure front cover) and shrinking it down to fit onto a small area of the screen. This can result in details becoming lost, and the overall effect being indistinct. Images are much better if designed for the size they are displayed in. If an image zoom function is required, it should be implemented in discrete steps (e.g. 2x, 4x or 100%, 200%), and by pointing at the area on screen which is to be zoomed in or out. The aspect ratio should also be kept constant. Finally, the user should not have to scroll the default sized image to see the complete picture.

10.7. GRAPHICS

Graphics (or diagrams) are good for schematic representations, expressing ideas, or for showing futuristic objects. Where an image is of poor quality (although the image may be improved with an editing package), and contains a certain amount of detail, a graphic may be clearer than a photograph. Graphics can be used to show things that do not exist in reality, and can be used to simplify a picture or accentuate or highlight essentials. A graphical expression should be as simple and pure as possible. Noirhomme-Fraiture and Vanderdonckt (1993) recommend the use of high-quality graphics to enable users to absorb the information they contain easily. Sometimes black and white graphics with high-quality grey shades are more legible than too colourful an illustration, especially as

colour displays do not always render all the colours as intended. Graphical coding of objects can be effective; for example, different-shaped elements representing components on an electrical circuit, colours to show political boundaries on a map, line lengths and angles to represent wind speed and direction, etc. Careful design is needed to avoid inappropriate graphical coding and the overuse of graphical codes (Vossen *et al*., 1997).

10.8. SPEECH OUTPUT

There is a growing use of speech output to provide guidance, to supplement screen information or to transmit information as part of a multimedia presentation. If it is necessary to maintain a quiet environment, e.g. in a cathedral or library, the use of a telephone handset or surrounding screens can mask the speech output. For general information being presented via a kiosk in an open environment, the use of speech is acceptable provided it is not obscured by passing traffic or other sounds.

As suggested by Noirhomme-Fraiture and Vanderdonckt (1993), speech synthesis should be used to reinforce visual channels e.g. vocal transcriptions of screen titles, labels and questions. In this way speech is able to reinforce screen text. In a presentation by Schofield (1997) about the Daewoo car showroom system for the public, speech was used to describe buttons as they were being displayed on screen. This allowed people to become familiar with a screen before interacting with it. Speech output can facilitate kiosk use for people with visual impairments. If used in this way, the speech output channel should be an alternative to screen output and provide appropriate prompts for input, e.g. via speech or input keys supporting tactile identification. A speech output volume control will assist people who have hearing impairments although the control itself must be easily identifiable.

Users generally prefer natural speech over synthesized speech as it is more intelligible. However, as technical improvements occur and features of natural speech such as rhythm and intonation are included, this becomes less of an issue. General recommendations for speech output with kiosks (drawn from Clarke *et al*., 1996; Vossen *et al*., 1997; Poulson, Allison, Ashby & Maguire, 1998) are to avoid using speech output for confidential information. Use of speech should also be limited to short messages (particularly for instructions) so that users can remember the content. Speech should be used sparingly when the system is in a public place to avoid sound pollution. Having a visible speaker can add impact to the voice output and, as an "interface agent", can point to items on the screen. However, for short messages or information referring to the primary visual scene, a simulated speaker is not needed and can be disruptive.

10.9. MUSIC

Music can provide extra information. For example in a multimedia presentation about Mozart, excerpts from his works might be included to supplement the pictures and text, or, if about John Kennedy, short sections from his speeches can be used to add impact. Music can be used as background to set the scene, or raise the user's attention by adding dramatic elements. If musical sequences are used, it is important that copyright is not infringed. It is also helpful to show the actual position and the total length of the music sequence on a time scale (Vossen *et al*., 1997).

11. Structure and navigation

11.1. USER-INTERFACE STRUCTURE

It is important that a kiosk system presents a clear and simple structure to the user (Maguire, 1983). By doing this, the user will feel more confident in moving or navigating through the system. The system should have a single starting point to which the users can return when they wish. This may be called the "starting screen", "main menu", or possibly the "home page". The interface should convey a clear structure to the user. Example structures are as follows.

- A sequence of screens, based on a hierarchical menu structure, where the user makes a selection at each stage in order to reach some useful information.
- A set of on-screen objects that, when selected, present information in a common window, dialogue box or speech bubble.
- A network of screens which allow the user to browse randomly supported by an overview map to show paths followed.

If the user is being presented with a sequence of screens, the system should try to show the path followed by the user or their position in a path. This may be achieved by a simple feedback message, e.g. "screen 2 of 5". If the user is moving down through a sequence of hierarchical menus (a maximum of three levels is recommended), it may be possible to present a conceptual pathway by showing the current menu partially overlaying the previous one.

Each screen should also have a clear title which is short and distinctive. This will help the user maintain the idea of their location within the system. To give the user a sense of consistency and control, a good approach is to split the screen up into a number of fixed panel areas containing different types of information, e.g. a "control panel" containing the main function buttons, a "menu panel" to display choices and an "information panel" to display information from the system. Hypertext links which allow the user the jump around within a network structure are appropriate for special applications where the user simply wishes to browse through screens looking for information of interest. However, users are unlikely to form a good mental picture of a network structure and so may find it hard to navigate with certainty.

11.2. NAVIGATION (GENERAL)

The user should be provided with some basic controls for navigating through the system. Examples of useful controls that may be considered are the following:

- Start, Finish, Restart—start or finish interacting or exit and start again.
- Back, Step back—go back to the previous screen or step in the interaction.
- Next page, Previous page—step through information screens.
- Enter, Select, OK—to end keyboard input, select menu option or acknowledge system message.
- Cancel, Exit—to cancel or exit from the current part of the system.

Note that "OK" is a useful general affirmative key label as it is a fairly common term in a number of European languages. If there was a need to provide a very simple interface,

this could be based on a series of straight questions to which the user may only be required to answer yes, no or don't know. This would allow the interface to be based on just three keys: "Yes", "No", "?", (first proposed by Evans, 1981) with possibly "Go back" and "Start/Finish" keys.

11.3. SOFT FUNCTION KEYS

Soft function keys are commonly used to support navigation through the system. Here a series of physical keys are placed alongside the screen, and input options presented adjacent to each one, which change for each screen. It is recommended that basic navigation controls used throughout the dialogue (e.g. up, down, OK, delete, help) are provided on dedicated keys, while context specific controls (e.g. withdraw cash, display balance, order chequebook, return card) are presented on soft function keys. Thus, on a bank machine, the labels may be used to represent different services. If the user presses "withdraw cash", the labels are changed to different monetary amounts to withdraw.

Thus, soft function keys offer a flexible means of interacting and are fairly intuitive. However, if the screen is poorly adjusted, the labels may become out of line with the keys, particularly for labels displayed horizontally, which the user is looking down onto. Lines on the user interface leading from the key to the surface of the display can alleviate this problem. Another general problem is that the physical keys may be placed too far from the screen labels, and it is not obvious that the two are associated. The benefit of having keys down the side of the screen rather than along the base is that more keys can be presented (if both sides are used) and the option labels can be longer.

11.4. MENUS

Menus provide an easy means of input for the kiosk user who can simply select the input they require at each stage in the dialogue from a list of options. Each menu option should be concise and clearly worded so that the user has a good idea of what they will get when making a selection. It may be useful to add a line of text alongside each option. Alternatively, as the user moves a selection bar down a menu list with, say an arrow key, additional information about each option can be displayed in an adjoining window (a feedback window). This technique has been used successfully by the author for a public system providing information on local training courses, with a three-level menu structure being used to select a course topic from a list of 1200 categories.

General menu design guidelines are as follows.

- Ideally, a maximum of 12 options should be presented on one menu. If this maximum is exceeded, the menu must be well structured (see following point).
- Menu lists require careful structuring, such as by alphabetical order, most commonly used options first or in the logical order in which they will be selected (e.g. search, display, print). Blank lines between groups of items in a menu can help emphasize the structure.
- If menu items are numbered, start from 1, and avoid gaps in the sequence. However, a common option, say, to exit should be given a consistent number throughout the system, e.g. 9, which may force a gap in the numbering on some menus.

- Avoid abbreviations in menu options unless well known to the public.
- Avoid technical or computer jargon in menu options.
- Try to avoid splitting a menu over two pages, possibly by having two columns of options on one page. If it is essential to split it over two pages, provide clear controls for "more options ..." and "return to previous options".

11.5. SYSTEM RESET

Make the system auto-reset after a few minutes if no input is made. So even when the system is abandoned in the middle of a dialogue by one user, the introductory screen will reappear ready for the next user. If the timeout has not occurred by the time the next user arrives, there should be a command allowing them to reset the system to the introductory screen immediately. However, auto-reset should not take place too quickly as it is very frustrating for a system to reset when a user is reading system output or deciding what step to take next (Maguire, 1983).

12. Flexibility and customization

Flexibility within the user interface to meet the varying needs of individual users is becoming well established. For example, a cash point machine could be equipped with a telephone receiver (Höynä, 1995) so that people with visual impairments could receive instructions in spoken language. Alternatively, voice output could be obtained via a connection point allowing users to plug in their own headphones. Such verbal support could also assist new users of a service that needs additional instructions.

Customisation of the user interface for a public system can also be useful. The SATURN project (RNIB, 1996) has tested the feasibility of bank customers carrying smart cards which carry information about each user's particular needs when operating a bank machine or other kiosk. The information would instruct the terminal to adapt to each person accordingly. Kiosk features that could be modified include: increased time before auto-reset occurs, larger characters, colour choice, speech output (of non-confidential information), language change, pictorial output, etc. Such a facility would be particularly helpful to the elderly and disabled but could also benefit the population of users in general.

Bank machines allow users to modify the interface to suit their own preferences. Choices include: (i) changing password and (ii) setting up a short cut for the most frequently required personal transaction. However, users may be reluctant to use such a facility without a clear explanation of what the process will entail.

13. Other stakeholders

It is important to consider the needs of kiosk users other than the general public. For example, it may be necessary for a member of staff at an information centre to use a system on behalf of a member of the public. Such users may need short cuts through the system, or the results of frequent enquiries saved, so that they can call them up easily whenever such enquiries are made.

It is important to consider the needs of the people maintaining the information in the system. If it is not easy to update the information, then the tendency is for it to be left and

become out of date. There are some advantages in updating the system locally (i.e. flexibility of content, not depending on the reliability of a central service) and other advantages in updating it centrally (i.e. consistent style, more efficient). This decision has to be made in the context of the specific application.

14. Testing kiosk systems

If a prototype system for the public is being tested, then the following factors are worth considering to help ensure that the results are valid and will transfer to the real environment.

- If testing with user subjects, then make sure that a fair proportion of users have little or no previous experience of interactive systems. Such users will normally tend to pose unexpected problems for the system and will therefore test the system more thoroughly.
- If possible, include elderly and disabled users. Any physical impairments of people in these groups will also test whether the system meets the need of "design for all".
- If relevant to them, include children in the test sessions. Also as children are often attracted by the presence of a kiosk, their interest may encourage the adults accompanying them to also interact with the system.
- Define a set of possible scenarios of use and specify representative tasks based on them. It may not be possible to test all parts of the system, so concentrate on the most common and/or the most critical tasks.
- The main concern in terms of user performance is whether users can complete tasks smoothly without too many errors, rather than their speed of performance. Many people, if confronted with a new system are happy to work through it step-by-step fairly slowly to complete a task, rather than rush through it.
- Obtain user comments to complement performance measures. Users opinions may differ from what one would expect when viewing their performance times.

15. Conclusion

Systems for the general public are now in widespread use, and are likely to increase as organizations recognize them as a cost-effective means of offering information and services to the public. It is clear that a proportion of the public, particularly those with experience of interactive systems, will be able to use them successfully. However, the public includes a wide range of differing levels of experience, of ability and of confidence. Care is required in the design of public information systems if the services they offer are not to be denied to large sections of the population. This paper has tried to provide some general assistance which tries to help designers towards achieving interfaces to match as a wide range of the general public population as possible. A summary of the main recommendations are provided in an appendix table to this paper.

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Appendix: Summary of recommendations for public information systems (See text of paper for further details)

Topic area	Recommendations
Defining user requirements	Determine user population for kiosk. Develop typical task scenarios and consider usage in relation to user characteristics and the possible operating environment. Obtain user feedback on system concept.

Appendix (Continued)

Topic area	Recommendations
Location and encouraging use	Advertise system through different sources rather than relying only on users noticing the system when passing by. Place logically within flow of movement but not in the way of passers-by. Provide large, high contrast signposting to cater for different levels of vision. Provide a bright attractor screen, and if possible a self running demonstration to indicate purpose of system and how to use it.
Physical access	For wheelchair use, the operable part of the user interface should be between 0.7 and 1.2 m in height, with clear area of 1.5 m radius around the terminal. Make the screen viewable from the wheelchair and allow people with low vision to get their faces up close to the screen. Provide recess underneath the terminal for wheelchair. Provide a well lit, funnel-shaped, card entry slot.
Introduction and instructions	Use off-line material such as posters and leaflets to present a system introduction and step-by-step instructions. (Leaflets can be taken away and studied at leisure.) On-screen instructions should be concise and should include graphical representations of corresponding interface elements. A short free running demonstration can save presenting lengthy instructions.
Language selection	Allow language to be chosen with a menu of options, each option in the language to be presented. Alternatively allow the user to select an appropriate national flag. Where the system cannot offer different languages, try to offer some level of multilingual human support.
Privacy	Provide some level of privacy, particularly for when the user is receiving or entering personal information, e.g. recessed screen and keyboard or locate in a booth. For wheelchair users, a seated version may be needed for privacy. For applications where privacy is less critical, place terminal to one side of main thoroughfare. Any use of sound should be at a low level.
Help	Help should be accessible with a single action (e.g. button press) and be interruptable at any time. Make help information concise and task/content related. Review the interface to see where on-line help may be needed at each stage of the user-system dialogue.
Input to the system (general)	Keep inputs simple, consistent and only require the user to specify one option at a time. For pointing use a touch screen or roller ball. (a mouse could be detached and stolen, unless supervised). For open air systems, input devices must be robust to stand up to continued use, the weather and vandalism. For text/numeric entry, clearly highlight the input box and distinguish system text from entry text. Provide a simple backspace or clear key.

Appendix (Continued)

Topic area	Recommendations
Keyboard input	For keyboard input, use "moving" keys with definite travel. Custom keyboards are preferred, although a standard keyboard can be used with unnecessary keys blanked off. Avoid requiring double key actions (e.g. shift key). Avoid lengthy inputs to cut down on typing or spelling errors. (For on-screen keyboards, 3–4 characters max.)
Touch screens	For touch screens, the minimum touch area (allowing for gloved hands) should be 2.6 scm^2, with an angle of 30–45° from the vertical. Provide clear instruction for operating touch screen and feedback when button pressed. Ensure touch screens are cleaned regularly.
Speech input	Speech input with public systems reduces privacy and can be hampered by noise pollution. However, it can offer benefits for visually impaired users. For speech menu selection, provide goal-action sequence and keep number of options to a maximum of 4 or 5 at each stage. Only try to match inputs with the subset of the vocabulary which is valid at that point is the dialogue. Consider the use of "word spotting" and "barge-in". For regularly used service terminals offer users training or practice.
Text and colour	Text should be a minimum of 16 point. Use simple font styles without serifs. However, serif fonts can be used to distinguish user input from system text. Ensure contrast between text and background is high. Use familiar language that the public will understand. Colourful displays can be attractive but avoid the use of too many colour codes (4 to 5 maximum). Use colour coding to supplement other forms of coding, e.g. text case, text font, symbols, shapes, patterns etc.
Icons	Icons should be simple, understandable and distinguishable. Test out proposed icons to check whether they are usable by members of the public. Explain icon meanings on a help page or with text labels. Use standard icons where possible. Consider combining icons with text labels.
Feedback	For system delays of more than 3 s, provide feedback that processing is taking place.
Images and graphics	Photographs or images are good for representing factual or documentary information. Images help to supplement text, but too many images can reduce their impact. When changing the image size, ensure details still visible. Do not require the user to scroll to see a complete image or graphic.

Appendix (Continued)

Topic area	Recommendations
	Graphics are good for schematic representations and expressing ideas and concepts. Graphical coding of objects can be effective, e.g. shapes to show elements on a circuit board.
Speech output	Speech output can supplement screen information and is especially useful for people with visual impairments. Use of a telephone handset or screens can prevent surrounding noise from drowning speech output. Natural speech is generally preferred to synthetic. Use short messages to avoid overloading the user and causing sound pollution in a public place. A visible speaker (or agent) can add impact to voice output but for short messages this can be disruptive. Never use speech for personal or sensitive information.
Music	Music can be used as background to set the scene or to raise the user's attention. It can be helpful to show the length and current position of a musical sequence on a time scale.
Structure and navigation	Create and present a clear and simple navigation structure to the user. Show the user's current position in the structure. Give each screen a distinctive title. Split screen up into panels containing different types of information. Provide basic navigation controls used throughout the dialogue (e.g. up, down, OK, delete, help) on dedicated keys, and context specific controls on soft function keys. Allow the system to reset after a few minutes and provide a "start" key to cater for abandoned dialogues.
Soft function keys	Soft function keys provide a convenient way of providing navigation task options at different points in the dialogue. Connection lines between the screen labels and keys can help to overcome parallax problems.
Menus	Avoid long menus (ideally having 12 options or less) and avoid splitting a menu over two pages. Present menu list in logical, alphabetical or temporal order. Blank lines in a menu can help to group menu options. Avoid abbreviations and jargon in menu options.
Flexibility and customization	Allow flexibility to cater for different personal needs, e.g. telephone-based speech instructions for people who are visually impaired or for guidance for new users. Consider allowing the user to customize the system to support their most frequent transactions (e.g. on a bank machine), or to adapt the system to their skills and abilities. A clear explanation of what is involved should be provided for the user beforehand.
Other stakeholders	Consider the needs of other users as well as the general public end users, e.g. data entry staff, maintenance staff.

Appendix (Continued)

Topic area	Recommendations
System testing	Include, within the system test programme, some users who have little or no experience of interactive systems, as well as elderly and disabled users, and possibly children. Develop tasks from typical scenarios. Aim to achieve error free test performance or task completion without help rather than focusing upon task time. Consider user subjective views as well as user performance.

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