

# GUI aspects and literature concerning GUI access by blind users

***Citation for published version (APA):***

Poll, L. H. D., & Waterham, R. P. (1992). *GUI aspects and literature concerning GUI access by blind users*. (IPO rapport; Vol. 855). Instituut voor Perceptie Onderzoek (IPO).

***Document status and date:***

Published: 03/06/1992

***Document Version:***

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

***Please check the document version of this publication:***

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

***General rights***

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

[www.tue.nl/taverne](http://www.tue.nl/taverne)

***Take down policy***

If you believe that this document breaches copyright please contact us at:

[openaccess@tue.nl](mailto:openaccess@tue.nl)

providing details and we will investigate your claim.

Institute for Perception Research  
P.O. Box 513 - 5600 MB Eindhoven

LP/lp 92/04  
03.06.1992

Rapport no. 855

GUI aspects and literature  
concerning GUI access by  
blind users

L.H.D. Poll and R.P. Waterham

# Contents

<b>1</b>	<b>Introduction</b>	<b>2</b>
<b>2</b>	<b>GUI basics</b>	<b>2</b>
<b>3</b>	<b>GUI objects</b>	<b>3</b>
3.1	Mouse pointer . . . . .	3
3.2	Icons . . . . .	4
3.3	Buttons and scroll bars . . . . .	5
3.3.1	Buttons . . . . .	5
3.3.2	Scroll bars . . . . .	5
3.4	Windows . . . . .	6
3.5	Dialog boxes . . . . .	8
3.6	Menu's . . . . .	10
	<b>References</b>	<b>12</b>

# 1 Introduction

Due to the extending use of Graphical User Interfaces (GUI's) in the office environment, blind or partially sighted users of computer programs are no longer able to work with their computer and its applications. In order to find a way to make the GUI's accessible for those people, a categorization is made of all the GUI aspects. It appears that GUI's look more different then they really are. This of course can help us in finding a translation of the GUI environment to an environment that is accessible by the blind or partially sighted user. We can here think of reconstructing a command-line structured interface, which has proven to be accessible to blind or partially sighted users with the assistance of Braille or synthetic speech.

This report will discuss the different aspects of GUI's, as far as they are related to the use in an office environment. Also this report will give a list of literature references related to this subject and the general subject of making GUI's accessible for the blind.

Nowadays several Graphical User Interfaces (GUI's) are available for different machines or even the same machines. The following three are presumed to be the most commonly used GUI's in an office environment:

**Finder:** Used on the Apple Macintosh.

**Presentation Manager (PM):** Used on personal computers which are running the operating system OS\2.<sup>1</sup>

**Microsoft Windows (MS Windows):** Used on personal computers which are operated by MS-DOS or PC-DOS.

Chapter 2 and 3 will give a summary of the objects and action that all three GUI's have in common. Extensions or exceptions of a particular GUI will be mentioned separately.

## 2 GUI basics

The basic idea behind a GUI is to provide the user of a computer an environment which is consistent in its use and allows the *user* to control the dialog (so called direct manipulation.) For this reason the windows environment and its applications are build with the help of objects. All GUI-environment manufacturers have defined a set of standard objects, which should be used by programmers writing GUI application programs in order to garantee consistency between programs. The easiest way to extract the

---

<sup>1</sup>OS\2 version 1.x is considered in this article. Version 2.0 will be analysed as soon as possible.

objects of a GUI is therefore to look into the programmers guides provided by the GUI-manufacturers.

### **3 GUI objects**

All objects consist of graphical items which can be divided into three classes:

1. Text
2. Arrays
3. Graphics

Items from one class can be mixed with items from another or even with items from the same class. E.g. an array can contain text, graphics or both, or another array which contains etc.

As mentioned previously, all GUI objects are build with items from one or more of these classes. The objects can be divided into the following groups:

1. Pointers
2. Icons
3. Buttons and scroll bars
4. Windows
5. Dialog boxes
6. Menu's

Each group will be discussed in the next paragraphs. Apart from their graphical representation the manipulability of these objects will be discussed.

#### **3.1 Mouse pointer**

The mouse pointer is a small graphic that can be moved around the screen by moving an input device named a mouse. The shape of this pointer indicates the state of the system. Normally it has the shape of an arrow, but images indicating e.g. a busy state (a wristwatch in the Finder) are also provided (see figure 1) A mouse has one or more buttons but all GUI's support a mouse with a single button. If a mouse has more than one button we mean by speaking of the button the left button of a mouse. With this pointer and the mouse the user can manipulate the several GUI objects. Possible actions are:

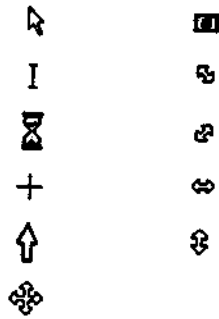


Figure 1: Several shapes of the mouse pointer

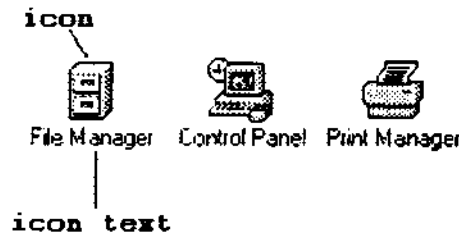


Figure 2: A few icons

**pointing:** Placing the mouse pointer on an object.

**selecting:** Clicking the mouse button once after pointing to an object. In case of the object being a button we can also speak of pressing.

**activating:** Pressing the mouse button twice after pointing to an object.

**dragging:** Holding down the mouse button after pointing to an object and moving the pointer. This will cause the object to move to another location.

### MS Windows & PM

These GUI's support mouses with two or more buttons but in general all the necessary actions can be performed by using the left mouse button.

### 3.2 Icons

Icons are graphical symbols that can serve several purposes. A few examples of an icon is are shown in figure 2.

They can be used to represent programs, datafiles etc. on the screen. The files can be selected by moving the mouse pointer to the icon and pressing the button of a mouse twice. An icon can also be moved around by 'dragging' it with the mouse pointer. Basic idea behind these icons is that pictures sometimes say more than words.



Figure 3: A default button and a non-default button

## MS Windows & PM

In these interfaces an icon can also represent a running program. Activating this icon by the mouse will make the original application window reappear. Pressing the mouse button once with the pointer on this icon will show a so called system pop-up menu which will be discussed in section 3.6.

### 3.3 Buttons and scroll bars

#### 3.3.1 Buttons

Buttons can be used to initiate certain actions. A button can be 'pressed' by clicking the mouse button once. The action that will be initiated by pressing a button is represented by a text or a small graphic on the button. Except from selecting a button with the mouse a default button can be pressed by pressing the 'Enter' or 'Return' key of the keyboard. A default button has a thick line around it's borders.

#### MS Windows & PM buttons

MS Windows and PM buttons are also accessible by short keys or so called accelerators. The short key to select and press a button is indicated by an underlined character of the button text. Pressing this key on the keyboard will select the button.

#### 3.3.2 Scroll bars

A scroll bar is a graphical representation of three related numbers: a minimum, a maximum and a current value that lies between the two. The objects that form a scrollbar are listed in figure 4. By dragging the slider box, the contents of a related single dimensional array can be moved between a minimum and a maximum. Selecting a scroll arrow button moves the slider box and the contents of the related array a little bit in the arrows direction.

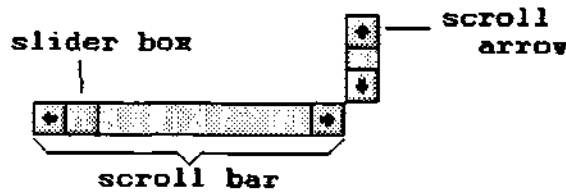


Figure 4: A vertical and horizontal scroll bar

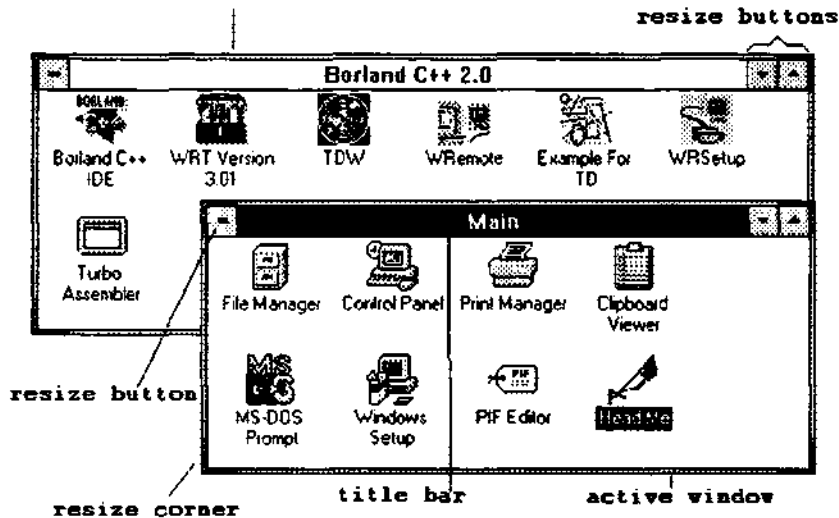


Figure 5: Active and inactive windows

### 3.4 Windows

Windows are rectangles of variable size. They can be moved around the screen and also overlap each other. A window can be active or inactive (See figure 5). The user can manipulate the contents of an active window. An active window will also be the top window, in other words will overlap windows that have (partly) the same location. An inactive window can be activated by selecting it. Only one window can be active at a time. An exception are the multiple documents. Here a main window and one of its child windows can be active at the same time! (See figure 6). A window can be divided in two areas: a client and non-client area. The client area is formed by the inner rectangle that contains the specific application, e.g. the text editing area of a wordprocessor (See also figure 5). The non-client areas contain those objects that are directly related to the window itself. These items will now be discussed. The objects that might be available in the non-client area are:

**resize corner:** This graphic is located at the bottom right corner of a window. Dragging this graphic to an other location resizes the window.



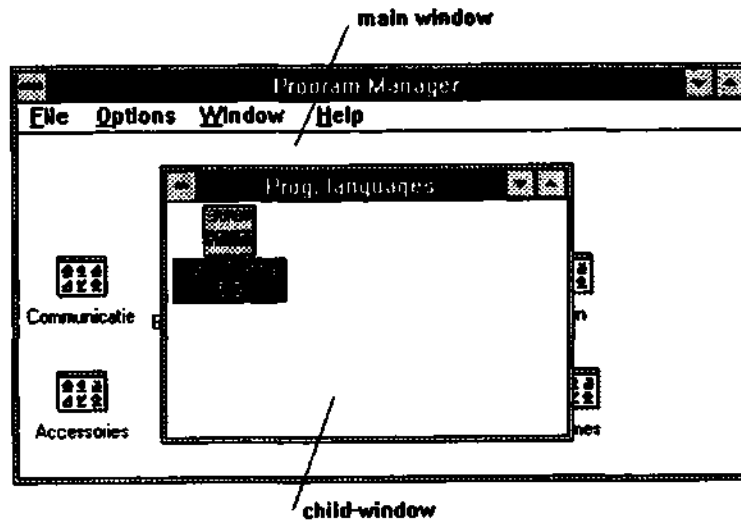


Figure 6: An example of the multiple document interface

**close button:** Pressing this button will close the window.

**title bar:** This bar on top of the window contains the title of the window.  
 Dragging this bar will move the entire window.

**scroll bar:** The function of a scroll bar is already discussed in paragraph 3.3.2.

### MS Windows & PM

These GUI's offer a few extensions to the general GUI windows.

- a maximize button at the top right corner of the window.
- a minimize button next to the maximize button.
- the resize corner is available in all or no corners of the window.
- a window can also be resized by dragging the borders of a window. If no resize corner is available no window resizing can be done at all.

The close button in these interfaces is in fact no real button but actually behaves more like an icon. To close the window the close "button" has to be pressed twice instead of once. Selecting this icon will show a system menu just like the system menu of icons that represent running programs (3.2).

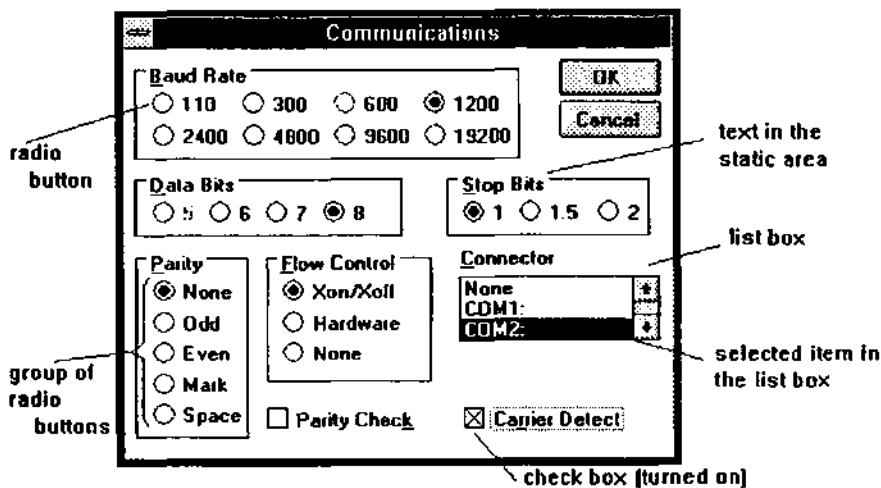


Figure 7: Several tools in a dialog box

### 3.5 Dialog boxes

A special kind of window is a so called dialog box. Users provide the dialog box with information that an application needs to continue. Dialog boxes can be moved by dragging them but the size can't be changed. Generally there are two types of dialog boxes:

**modal boxes:** These boxes prevent the user from interacting with other windows of the application until the information request of a box is handled properly. Dialog boxes may be specified as a system modal or application modal. Application modals allow a user to work in a window of another application before completing the dialog box. System modals should be finished before the user is allowed to work in another window.

**modeless boxes:** These boxes allow a user to interact with other windows of another or even the same application without first completing the dialog box.

To receive information from the user in a consistent manner the following tools are used within dialog boxes (See also 7):

**push button:** Already discussed in paragraph 3.3.1

**scroll bar:** Already discussed in paragraph 3.3.2

**radio button:** Radio buttons always appear in groups. Only radio of the same group can be turned on at a time. If another radio button of the group is selected the previous one will be turned off automatically.

**check box:** A check box can appear alone or in related sets. A check box acts like a switch. Program features can be turned on and off by selecting the check button. Multiple buttons of a related set can be turned on or off.

**edit control:** This object allows the entering of text or a selection . There are four types of edit controls.

1. Single-line edit.
2. Multiple-line edit.
3. Multiple-line edit that allows vertical scrolling.
4. Multiple-line edit that allows vertical and horizontal scrolling.

An edit control appears as a single rectangle in which text can be edited. In case of tools of type 3 and 4 scroll bars are available to allow entering text of a larger size than the size of the rectangle.

**list box:** This box shows the user a set of items that can be selected (e.g. a list of fonts). The most common type of list box contains text, but graphic images can also be drawn into the a list box if a set of choices is best represented by a picture instead of words. If it is a list in a list box is

**static areas:** The static areas can contain objects like icons, text labels, filled rectangles etc. that contribute to the general function of a dialog box but do not interact with the user directly. A special object of a static area is a group box. This is a rectangle with a title that is used to group radio buttons or to define a set of related check boxes.

**dials:** Programmer definable controls that can indicate things like values, magnitudes, or position of something in the application or system, and optionally allow a user to alter that value of one of these controls. In fact a scroll bar is a special kind of dial.

## **MS Windows & PM**

A control box in one of these GUI's can also contain a combination box or combo box. This is a combination of an edit control and a list box. The list box is placed underneath the edit control. Items selected in the list box are placed automatically in the edit control. Separate entering of text or altering of text in the edit control is also possible. A special kind of combo box is the drop-down combination box. Only the edit part of the control is shown in the dialog box. If this part is selected, the list part appears under the edit control. As soon as a selection is made or the editing is done the list box

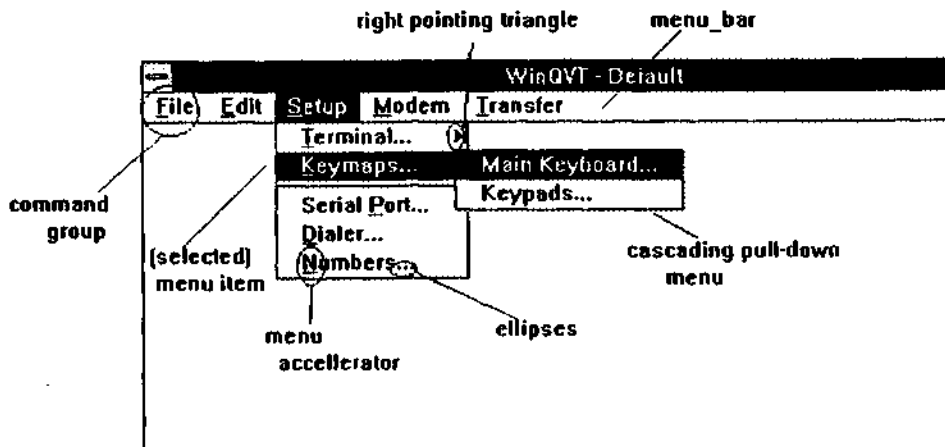


Figure 8: Menu based GUI command interpreter.

disappears. Sometimes it is not possible to edit the text in the edit control. To indicate that an edit control will turn in a drop-down combination box as soon as selected, a visual clue is added to the right of the entry field. A dialog box can be closed in several ways depending on the type of box:

- A modal dialog box can be closed by:
  1. pressing the 'OK' button or another button that completes the dialog.
  2. pressing the 'Cancel' button.
- modeless dialog box can be closed by:
  1. pressing the 'Cancel' pushbutton.
  2. closing the window of the dialog box.

### 3.6 Menu's

Each application can have its own menu action bar which is placed at the top of a window. A menu bar consists of verbs and adjectives which summarize the possible command groups. If a command group is selected the command is highlighted and a pull-down menu list appears as long as the mouse button is pressed. A menu bar and a pull-down menu list are displayed in figure 8. The menu list contains command items which can be activated by moving the mouse pointer to the item to select and the release of the mouse button will finally select the command. Pointing to an item of the list with the mouse pointer automatically highlights the item. Sometimes the menu list is divided by horizontal lines in subgroups of command options. Apart from the menu item text itself several visual cues can be used to give an indication of the kind of action a selection invokes:

- A command item can also be followed by an ellipsis indicating that a dialog box will appear if the command is selected.

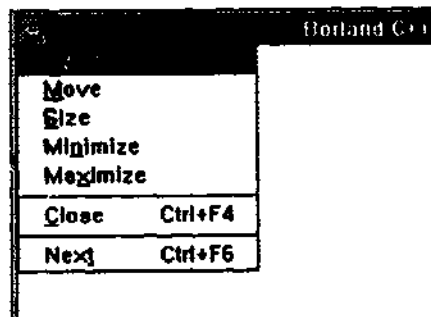


Figure 9: MS-windows 3.0 system pop-up menu

- A right pointing triangle indicates that selection of the item will activate a cascading pull-down menu.
- Verbs indicating options can be preceded by a check mark showing that the option is selected. These kind of check marks are called current state indicators.
- A dimmed text of a menu item means that the particular menu item is currently not available.

Other visual cues are concerned with alternative ways of accessing the menu items:

- Some menu items can also be directly activated by the keyboard. The key combinations to do this (so called accelerators) are displayed on the right next to the menu item, if available.
- The underlined character of a menu item can also be used to activate it without the use of a mouse. These will be called menu accelerators.

Except from text also graphics can be used to indicate menu choices.

## MS Windows & PM

As mentioned in paragraph 3.2 and paragraph 3.4 selecting the icon of a running program or selecting the close button of a window activates a system pop-up menu (Figure 9). This menu behaves in the same way as the pull-down menus of an action bar.

## References

- [1] Adjouadi, M.  
1985, Computer Vision Techniques to aid the blind.
- [2] Allen, S.I.; et al.  
1981, A voice output module for a blind programmer. ,*Journal of Visual Impairment and Blindness* ,75 (4) ,p157-161
- [3] Amick, N.S.  
1982, Designing useful drawings for the blind. ,*Tactual Perception: a sourcebook* ,p420-452
- [4] Anbary, Y.; Mardiks, E.  
1982, A computer terminal with a single-cell braille display. ,p367-376
- [5] Apkarian-Stielau, P.; Loomis, J.M.;  
1975, A comparison of tactile and blurred visual form perception. ,*Perception & Psychophysics* ,18 ,p362-368
- [6] Arditi, A.; Gillman, A.E.  
1986, Computing for the blind user ,*Byte* ,11 (3) ,p199
- [7] Assimacopoulos, A.  
1990, Blind students using a computer in a regular classroom: a first look at an ongoing experiment. ,*Proceedings of 6th International Workshop on Computer Applications for the Visually Handicapped* ,4 (3) ,p1-6
- [8] Bacchyrita, P.  
1983, Tactile Vision substitution - Past and future ,*Int. J. Neurs* ,19 (1-4) ,p29-36
- [9] Barth, J.L.  
1984, Enhancing the readability of tangible graphs for the blind ,*Human Factors* ,26 (1) ,p61-70
- [10] Bentzen, B.L.  
1980, Orientation Aids ,*Foundations of Orientation and Mobility*.
- [11] Berlá, E.P.  
1982, Haptic perception of tangible displays. ,*Tactual Perception: a sourcebook* ,p364-386
- [12] Bertin, J.  
1981, Graphics and graphic information-processing.

- [13] Blattner, M.M.; Sumikawa, D.A.; Greenborg, R.M.  
1989, Human Computer Interaction , (4) ,p11-43
- [14] Bliss, J.C.; Katcher, M.H.; Rogers, C.H.; Shepard, R.P.  
1970, Optical-to-tactile image conversion for the blind ,IEEE Transactions on Man-Machine-Systems , (11) ,p58-64
- [15] Bly, S.  
1982, Sound and computer information processing
- [16] Boldt, W.  
1988, Blindheit und die 'Neuen elektronischen medien" , (48) ,p1-6
- [17] Breede Van den, G.  
1990, Telebanking Systems & Intelligent Houses for the Visually Impaired. ,Proceedings of the 6th International Workshop on Computer Applications for the Blind. ,4 (3) ,p1-6
- [18] Brown, E; Buxton, W.; Murtagh, K.  
1985, Windows on Tablets as a Means of Archiving Virtual Input Devices.
- [19] Buxton, W.;  
1986, Human Interface Design and the handicapped user ,CHI'86 proceedings ,p291-297
- [20] Buxton, W.; Hill, R.; Rowley, P.  
1985, Issues and Techniques in Touch-Sensitive Tablet Input
- [21] Buxton, W.; Lee, S.K.; Smith, K.C.  
1985, A multi-touch three dimensional touch-sensitive tablet ,CHI'85 Proceedings ,p21-25
- [22] Castellini, C.; Emiliani, P.L.; Graziani, P.; Tronconi, A.  
1986, Integrated Communication Aid for the Blind ,IEEE ICASSP 86. ,p657-660
- [23] Castellini, C; Emiliani, P.L.; et al.  
1981, A voice synthesizer for blind computer interaction. ,Proceedings of the 4th FASE Symposium on Acoustic and Speech
- [24] Cholewiak, R.W.; Craig, J.C.  
1984, Vibrotactile Pattern-recognition and discrimination at several body sites. ,Perc. Psych. ,35 (6)

- [25] Craig, J.C.  
1985, Attending to 2 fingers - 2 hands are better than one. ,Perc. Psych. ,38 (6) ,p496-511
- [26] Craig, J.C.; Sherrick, C.E.;  
1982, Dynamic tactile displays. ,Tactual Perception: a sourcebook. ,p209-233
- [27] Deatherage, B.H.;  
1972, Auditory and other sensory forms of information presentation ,Human engineering guide to equipment design. ,p123-160
- [28] Deconinck, F.  
1990, A scientific look at images ,Access to Visual Computer Information by Blind Persons ,p109-111
- [29] Deconinck, F.; Stephanidis, C.; Weber, G.  
1991, Access to pictorial information by blind users. ,Proceedings of North Sea Conference on Biomedical Engineering.
- [30] Decoret, C.  
1990, Role of computer and technical aids in the development of a resources center for visually impaired students. ,Proceedings of the 6th International Workshop on Computer Applications for the Blind. ,4 (3) ,p1-7
- [31] Deese, V.; Grindley, G.C.;  
1947, The transposition of visual patterns. ,British journal of psychology , (37) ,p152-163
- [32] Dörn, C.  
1984, The speech-pad: direct manipulation computer access for the visually disabled based on speech and touch.
- [33] Dürre, K.; Schmidt-Lademann, F.P.  
1983, Interactive Computer Interfaces for the blind. ,Proc. IEEE Computer Soc. Workshop on Computers in the Employment and Education of the Handicapped. ,p89-96
- [34] Dürre, K.P.  
1986, Braille and Advanced Man-Computer Interaction ,Proceedings Computerised Braille Production
- [35] Edwards, A.D.N.  
1990, Adapting the Macintosh and Other Graphical User Interfaces for blind users. ,Proceedings of the 6th International Workshop on Computer Applications for the Blind. ,4 (3) ,p1-9



- [36] Edwards, A.D.N.  
1987, Adapting user interfaces for visually disabled users.
- [37] Edwards, A.D.N.  
1989, Soundtrack: An auditory interface for blind users. ,Human Computer Interaction ,4 ,p45-56
- [38] Elliott, F.R.  
1937, Eye versus ear in moulding opinion ,Public opinion Quaterly , (1) ,p83-85
- [39] Emiliani, P.L.  
1990, Applications of Technology in the Social Integration of Visually Disabled Persons. The poin tof view of Research. ,Proceedings of the 6th International Workshop on Computer Applications for the Blind. ,4 (3) ,p1-12
- [40] Emiliani, P.L.,  
1989, Concerted Research Programme on Technology and Blindness. ,Conference on Computers for Handicapped Persons: ,p344-350
- [41] Emiliani, P.L.; Graziani, P.  
1989, New Perspective in the Access to Information by the Blind. ,Proceedings of the First International Conference on Computers for Handicapped Persons: ,p351-358
- [42] Erhard, R.; et al.  
1977, Hochauflösende Umsetzung von bildern in eine taktile Darstellung für Blinde. ,Technologische Forschung und Entwicklung. ,p77-93
- [43] Esche, S.  
1985, Entwurf und Implementierung eines Programms zur interstützung blinder Bildschirmtext-Teilnehmer
- [44] Fahlman, S.  
1979, A system for representing and using real-world knowledge ,NETL
- [45] Fehrle, T.  
1985, Ein rechnerunterstützter Zeichenplatz für Blinde
- [46] Fellbaum, K.  
1990, Access to Visual Computer Information by Blind Persons
- [47] Fischer, G.; Lemke, A.; Schwab, T;  
1985, Knowledge-based help systems ,Human Factors in Computing System ,p161-167

- [48] Foulke, E.  
1982, Microcomputers, VIPs and the communication Network. ,Uses of Computers in Aiding the Disabled ,p393-403
- [49] Foulke, E.  
1982, Reading braille. ,Tactual Perception: a sourcebook. ,p172-208
- [50] Frank, J.  
1990, Tactile acoustic cursor, in Electronic Appliances. ,p10-11
- [51] Gaver, W.  
1986, Auditory icons: Using sound in computer interfaces. , (2) ,p167-177
- [52] Gaver, W.W.  
1989, The Sonic Finder: An interface that uses auditory icons ,Human Computer Interaction ,4 ,p67-94
- [53] Goren, M.S.  
1984, The education and employment of the handicapped ,Computer society workshop on computers and the handicapped. ,p41-43
- [54] Gray, D.B.; LeClair, R.R.; Brummel, J.E.; et al.  
1987, Acces to information technology by user with disabilities: Initial guidelines
- [55] Graziani, P.;  
1986, Communication Aids for the Blind Based in a Personal Computer. ,Communication Systems For The Blind. Proceedings of a European workshop. ,p128-132
- [56] Graziani, P.; Monique Truquet  
1990, Computer Aided Procedures of Music Transcription and Compositin for the Blind. ,Proceedings of the 6th International Workshop on Computer Applications for the Blind. ,4 (3)
- [57] Havens, W.; Mackwort, A.  
1983, Representing knowledge of the visual world ,Computer ,16 (10)
- [58] Heller, M.A.  
1986, Central and peripheral influences on tactual reading. ,Perc. Psych. ,39 (3) ,p197-204
- [59] Hemenway, K.  
1982, Psychological issues in the use of icons in command menu's. ,Proceedings of the CHI'82 Conference on Human Factors in Computer Systems. ,p21-24

- [60] Herzog, H.W.; Kügler, M.  
1983, Untersuchung zu technischen Hilfsmitteln für Blinde ,Blindenschrift
- [61] Herzog, H.W.; Kügler, M.  
1982, Untersuchung zu technischen Hilfsmitteln für Blinde.
- [62] Hill, D.R.; Grieb, C.;  
1988, Substitution for a Restricted Visual Channel in Multimodal Computer- Human Dialogue ,IEEE Transactions on Systems, Man and Cybernetics ,18 (2) ,p285-403
- [63] Hillis, W.D.  
1982, A High Resolution Imaging Touch Sensor ,International Journal of Robotics Research ,1 (2) ,p33-44
- [64] Janssons, G.  
1983, Tactile guidance of movement. ,Int. J. Neurs. ,19 (1-4) ,p37-46
- [65] Kaczmarek, K.; Bachyrith, P.; Thompkins, W.J. et al.  
1985, A tactile vision-substitution for the blind - Computer controlled partial image sequencing. ,IEEE Biomed ,32 (8) ,p602-608
- [66] Kalina , U.  
1989, Braille window mouse: proposal for a new computer output device for the blind. ,Paper presented at the Workshop on Access to Computer Systems by Blind Persons.
- [67] Karshmer, A.; Myler, H.; Davis, R.  
1985, An inexpensive and portable talking-tactile terminal for ..
- [68] Kennedy, J.M.  
1982, Haptic pictures ,Tactual Perception: a sourcebook. ,p305-333
- [69] Kennedy, J.M.  
1983, What we can learn about pictures from the blind. ,AM Scient ,71 (1) ,p19-26
- [70] Kim, J.;  
1988, On-line gesture recognition by feature analysis. ,Vision Interface Proceedings ,p51-55
- [71] Kirchner, C.  
1979, Non-text reading matter: How should it be presented? ,Journal of Visual Impairment and Blindness. ,73 (8) ,p329

- [72] Kirse, U.;  
1990, Voice Navigator
- [73] Klatsky, R.L.; Lederman, S.J.;  
1985, Identifying objects by touch. An expert system. ,Perc. Psych. ,37  
(4) ,p299-302
- [74] Klöpfer, K.  
1985, An Electronic Appointment Book For the blind ,Proceedings of the  
4th World Conference on Computers in Education (WCCE85) ,p725-728
- [75] Klöpfer, K.  
1987, Ein multifunktionaler Büroarbeitsplatz für Blinde.
- [76] Klöpfer, K.  
1985, Eine Datenbank mit einer Benutzerschnittstelle für Blinde.  
,Software-Ergonomie '85
- [77] Klöpfer, K.; Schweikhardt, W.  
1983, Anpassung der benutzerschnittstelle des bildschirmtextsystems  
der deutschen Bundespost für blinde Teilnehmer. ,Informatik Fach-  
berichte
- [78] Klöpfer, K.; Schweikhardt, W.  
1984, Rechnerunterstützte aufbereitung von Bildschirmtextgrafiken in  
eine tastbare Darstellung. ,Tagungsband der Internationalen Konferenz  
über Refliedarstellungen für Blinde
- [79] Kochanek, D.  
1990, A hypertext system for blind readers of a newspaper.
- [80] Kochanek, D.  
1990, Tactile graphics and text reproduction.
- [81] Koenderink, J.J.  
in press, Zien ,Reading images by touch or vision, F. Deconinck ed.
- [82] Koller, F.; Hoppe, U.; Faulhaber, H.  
1986, Integration verschiedener Eingabetechniken in einer multi-  
modalen benutzerschnittstelle.
- [83] Lai Woa, E.; Truquet, M.; Djedi, N.; Caubet, R.,  
1990, Graphical creation aid for the Blind ,Proceedings of the 6th In-  
ternational Workshop on Computer Applications for the Blind. ,4 (3)  
,p1-11

- [84] Lauer, H.M.  
1981, Communication Media for the Blind: Why Isn't There One Best Way? ,Proceeding Fourth Annual Conference Rehabilitation Engineering. ,p271-273
- [85] Lederman, S.J.; Campbell, J.I.  
1982, Tangible Graphs for the Blind. ,Human Factors ,24 (1) ,p85-100
- [86] Lederman, S.J.; Kinch, D.  
1979, Texture in tactual maps and graphics for the visually handicapped. ,Journal of Visual Impairment and Blindness. ,73 (6) ,p217-220
- [87] Lemke, A.  
1984, Passivist: Ein natürlichsprachliches Hilfesystem für den bildschirmorientierten Editor Bisyl.
- [88] Lindström, J.L.;  
1986, Information Technology - How Does It Affect Visually Impaired People's Lives? ,(paper presented at the Technical Conference, Copenhagen, 1986)
- [89] Loomis, J.M.  
1981, Tactile pattern perception ,Perception ,10 ,p5-27
- [90] Lunney, D.; et al.  
1983, A microcomputer-based laboratory aid for visually impaired.. ,IEEE micro: chips, systems, software and applications ,3 (4)
- [91] Lunney, D.; Morrison, R.C.;  
1981, High technology laboratory aids for visually handicapped chemistry students. ,Journal of chemical Education ,58 (3) ,p228-231
- [92] Mansur, D.L.; Blattner, M.M.; Joy, K.I.  
1985, Soundgraphs: A numerical data analysis method for the blind. ,Proceedings: 18th Hawaii International Conference on System Sciences. , (18) ,p198-203
- [93] Marks, L.E.  
1983, Similarities and differences among the senses ,Int. J. Neurs. ,19 (1-4) ,p1-11
- [94] Marr, D.  
1982, Vision: A computational investigation into the human representation and processing of visual information.

- [95] Massaro, J.J.; Cohen, M.M.  
1983, Evaluation and integration of visual and auditory information in speech perception. ,Journal of Experimental Psychology: Human Perception and Performance. ,9 ,p753-771
- [96] Mayer, E.  
1986, Entwurf und implementierung eines Programms zur Wiedergabe von Bildschirmtextseiten in synthetischer Sprache unter Zuhilfenahme von tastbaren Graphiken.
- [97] Millar, S.  
in p, Haptic perception ,Reading images by touch or vision, F. Deconinck ed.
- [98] Millar, S.  
1984, Is there a best hand for braille? ,Cortex ,20 (1) ,p75-87
- [99] Millar, S.  
1985, The perception of complex patterns by touch. ,Perception ,14 ,p293-303
- [100] Parreno, A.; Magallon, P.J.  
1990, Monocell Braille line for IBM PC and compatibles. ,Proceedings of the 6th International Workshop on Computer Applications for the Blind. ,4 (3) ,p1-12
- [101] Pathak, K.; Pring, L.  
in p, Tactual picture recognition in blind and sighted children. ,Applied cognitive psychology.
- [102] Pring, L.  
in p, Getting in touch with pictures and words: Educational str .. ,International journal of rehabilitation research
- [103] Pring, L.  
in p, Learning through touch. ,Reading images by touch or vision
- [104] Recuero, A.  
1990, Is Scientific Research a Field forbidden for the Blind? ,Proceedings of the 6th International Workshop on Computer Applications for the Blind. ,4 (3) ,p1-6
- [105] Roffler, S.  
1967, Sound Localization in the Vertical Plane

- [106] Ronsse, C.  
1990, The IBM Workstation for the Blind ,Proceedings of the 6th International Workshop on Computer Applications for the Blind. ,4 (3) ,p1-3
- [107] Sasaki, L.; et al.  
1981, A Touch-Sensitive Input Device. ,Proceedings of the Fifth International Conference on Computer Music
- [108] Scadden, L.A.;  
1984, Blindness in the information age: Equality or irony? ,Journal of Visual Impairment and Blindness , (78) ,p394-400
- [109] Schiff, W.; Foulke, E.  
1982, Tactual perception: a sourcebook.
- [110] Schmidt-Lademann, F.P.  
1985, Eine grafikfähige Rechnerschnittstelle für Blinde. ,Software-Ergonomie '85 ,p355-365
- [111] Schmidt-Lademann, F.P.; Dürre, K.  
1984, Rechnerarbeitsplätze für Blinde. ,Proc. Offene Multi-funktionale Büroarbeitsplätze und Bildschirmtext. ,p303-316
- [112] Schreier, E.M.; Dewitt, J.C.; Goldberg, A.M.; Leventhal, J.D  
1987, An evaluation of synthetic speech software programs. ,Journal of Visual Impairment and Blindness. ,81 (2)
- [113] Schweikhardt, W.  
1983, 8-Dot-Braille for Representing Informations from Computers. ,Proceedings of The IEEE Computer Society Workshop on Computers in the Education and Employment of the Handicapped.
- [114] Schweikhardt, W.  
1982, A programming Environment for the Blind APL-Programmers ,13 (1) ,p325-331
- [115] Schweikhardt, W.  
1986, Access to the European Videotex-systems by blind subscribers ,Communication systems for the blind. ,p195-202
- [116] Schweikhardt, W.  
1985, Bildschirmtext- ein rechnerunterstütztes Kommunikatio .. ,p691-701
- [117] Schweikhardt, W.  
1981, Eine rechnerunterstützte Lern- und Arbeitsumgebung für Blinde

- [118] Schweikhardt, W.  
1984, Representing Videotex-pages to the Blind ,Proceedings of Third Workshop on Computers and the Handicapped. ,p23-29
- [119] Schweikhardt, W.  
1985, Teaching the blind to read tactile graphics by computer ,Proceedings of the 4th World Conference on Computers in Education (WCCE85) ,p719-724
- [120] Schweikhardt, W.; Fehrle, T.  
1988, Das Studium Informatik an der Universität Stuttgart. , (2) ,p51-55
- [121] Schweikhardt, W.; Fehrle, T.  
1986, Ein rechnerunterstützter Zeichenplatz für Blinde ,Proceedings Computerised Braille Production ,p251-261
- [122] Schweikhardt, W.; Klöpfer, K.  
1984, Rechnerunterstützte Aufbereitung von Bildschirmtext-Grafiken in eine tastbare Darstellung ,Tagungsband zur Internationalen Konferenz über Reliefdarstellungen für Blinde. ,p97-107
- [123] Schweikhardt, W.; Klöpfer, K.,  
1984, Computer Aided Conversion of Videotex-Graphics into a Tactile Representation ,Proceedings of the International Conference on Reliefs for the blind.
- [124] Songco, D.C.; Allen, S.I.  
1980, How Computer Talk to the Blind. ,IEEE spectrum ,17 (5) ,p34-38
- [125] Steele, R.D.; Miranda, R.F.  
1986, A multibus-compatible interface to selected reading displays for the blind. ,IEEE Biomed. ,33 (9) ,p896-898
- [126] Steinle, J.  
1984, Eine auf dem Bildschirmtextsystem aufbauende Datenbank für blinde Benutzer.
- [127] Stephanidis, C.; et al.  
1990, Some issues related to the accessibility of computer images by blind persons. ,Fellbaum K. (ed),:Access to Visual Computer Information by Blind Persons. ,p73-77
- [128] Stephanidis, C.; et. al.  
1990, Image Understanding and machine vision. ,Access to Visual Computer Information by Blind Persons



- [129] Stephanidis, C.; Weber, G.; et al.  
1991, Access to Graphical User Interfaces by blind people.
- [130] Strothotte, Th.;  
1990, Aspects of language and pictorial representations in Human-Computer Interaction. ,Access to Visual Computer Information by Blind Persons ,p61-67
- [131] Vanderheiden, G.;  
1990, Nonvisual alternative display techniques for output from ..
- [132] Vincent, T.  
1986, Computing and the blind
- [133] Warren, W.H.; Verbrugge, R.R.;  
1984, Auditory perception of breaking and bouncing events: A case study in ecological acoustics. ,Journal of Experimental Psychology: Human Perception and Performance. ,10 ( ) ,p704-712
- [134] Weber, G.  
1984, Ein Fenstersystem für Blinde
- [135] Weber, G.  
1987, Gestures as a means for the blind to interact with a computer. ,p593-595
- [136] Weber, G.  
1989, Interaktive Dialogtechniken für blinde Rechnerbenutzer
- [137] Weber, G.  
1990, Mensch-Maschine Interaction auf der Basis von aktiven Zeigehandlungen bei der Stuttgarter Stiffrplatte. ,Informationstechnische Bildung für Sehbeschädigte. ,p39-50
- [138] Weber, G.  
1989, Reading and pointing - modes of interaction for blind users. ,Information Processing 89 ,p535-540
- [139] Weber, G.  
1990, Two mice for blind users of the pin-matrix device. ,Proceedings of 6th International Workshop on Computer Applications for the Visually Handicapped ,4 (3) ,p1-13
- [140] Welch, R.B.  
1980, Immediate perceptual response to intersensory discrepancy ,Psych. Bulletin ,88 (3) ,p638-667

- [141] Wenzel, E.; Wightman, F.L.; Forster, S.  
1988, Development of a three dimensional auditory display system  
,SIGCHI Bulletin , (20) ,p52-57
- [142] Wiedenlübergert, S.  
1983, Gegebenheiten und Perspektiven der Berufsbildung Seh-  
beschädigter. ,Kongressbericht des 29. kongresses für Sehbeschädigten  
pädagogik in Würzburg
- [143] Wihofsky, J.;  
1990, A mouse-driven speech review program
- [144] Witte, R.F.V.  
1990, Acquisition and Presentation of Information for the Blind ,Com-  
munication Systems For The Blind. Proceedings of a European work-  
shop. ,p114-118
- [145] Yeung, E.S.  
1980, Pattern Recognition by Audio Representation ,Analytical Chem-  
istry. ,52 (7) ,p120-