TEACHING THE WINDOWS TO VISUALLY IMPAIRED INDIVIDUALS

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Abstract

This material provides an overview of the Windows operating system as well as an insight of what needs to be understood in order to teach visually impaired individuals how to use the Windows system. The material also covers the basics of computers and braille.

About This Document

This document was prepared to provide supplemental information for the presentation. Readers must understand that this document is incomplete and not intended to be used as a reference material. Please listen closely to the presentation, ask any questions as needed, and use this document to help yourself understand the presentation better.

Note: This document was revised in Feb 2004 to include additional topics covered during the 2004 training course.

Note: This material will be made available online online at:
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Contents

1   Windows Overview

This portion of the material provides an overview of the Windows OS. Below are some of the key terms.

1.1   General Terms

Operating System (OS)   A basic software that manages and provides access to various resource within computer system, such as memory, disk, and other hardware devices. It also oversees application programs running on the system. Basic user interface is also provided by the operating system. Popular operating systems include Microsoft Windows series, MacOS, and Unix.

Application Program   Software that provides more specific functionalities, such as word processor, spreadsheet, Email program, Web browser, etc. Application programs make use of the functionalities provided by the underlying OS to access various resource within the system.

Graphical User Interface (GUI)   In early years of computer age, users typed in instructions for computers to perform tasks. These instructions are called commands, and are typed in from the keyboard. With recent OS, users are not required to memorize all the commands to perform various tasks since most functionalities are accessible through interactions with objects on the screen. That is, there are small pictures of buttons and other items, called icons, displayed on the screen, and users point and click them with a pointing device. In many situations, however, there are alternative ways to perform the same task through the keyboard.

Pointing Device   A device used to point an arbitrary point on the screen. In most cases, this is a mouse. Track-ball and touch-pad are other popular pointing devices.

1.2   Windows System Related Terms

Login Screen   Users are presented with this screen after turning on the computer. This screen is a dialog box which prompts the user for the user

name and the password. After supplying correct user name and password, users are presented with the initial screen which consists of the Desktop, the Start Button, and the Taskbar.

Taskbar   This is a narrow area along the lower edge of the screen. Icons which represent application programs currently running are lined up in this area. Right hand half of the Taskbar is called "system tray," or "Systray." This area contains icons of programs that are currently running. Programs shown in this area may have no opened window associated with. Far right end of the Taskbar, next to the system tray area, is the clock. left to the system tray is the area where icons representing currently opened windows are shown. Left to that area, icons to launch certain programs are lined up, and these icons are called "quick launch icons."

Start Button   The Start Button is located to the left of the Taskbar. Clicking on this button brings up the "Start Menu." The Start Menu is a menu of programs and functionalities available to the user, and is customizable. The Start Menu can be brought up by pressing either the Windows key, or the CTRL+ESC keys.

Desktop   This is a large area above the Taskbar and the Start Button. This area is called the Desktop because it resembles the top of an office desk, where there are folders and documents placed. The Desktop is shown if there is no other window opened. It contains icons and associated text labels representing folders, documents, functionalities of the Windows OS, etc.

1.3   Windows

In most cases, when an application program is started, a rectangular area on the screen is used for interaction between the program and the user. This area is called "window." The interaction between the program and the user using a window is through displaying messages, accepting user inputs, presenting menus, etc. What is displayed in a window differs depending on the application program being used.

If there are multiple application programs running, there can be one window for each program. In this case, windows may be placed side by side, or

a window may be overlapping a part of another window. The layout of the windows can be adjusted by the user.

Size of windows is also adjustable. It can be as large as entire screen. When a window is occupying the entire screen, this window is "maximized." Windows can be "minimized" as well. When minimized, a window is represented as an icon on the Taskbar, in between the quick launch icons and the system tray.

In order for application programs to accept user input from the keyboard, the window associated to that program must be "focused." On focused window, a small symbol called "caret" is shown to indicate where the input is sent to. Caret is sometimes referred to as "cursor."

Title Bar   This is the upper edge of the window where name of the application program associated to the window is shown. Sometimes it also provides additional information such as name of the file being edited and so on. Right to the title bar are the buttons to adjust the window size. And left to the title bar is an icon, the control menu.

Menu Bar   In many programs, you can find a menu bar beneath the title bar. Several items are lined up horizontally, and these are categories of functionalities that can be accessed via the menu bar. Clicking on one of them brings up a menu of functionalities under that category.

Tool Bar   Some application programs place a tool bar below the menu bar. This is a series of buttons placed horizontally, and clicking on one of them activates certain functionalities. In most cases, functionalities accessible through the buttons on the tool bar are also accessible through the menu bar.

Parent And Child Windows   Often, one window contains another window. The outer window, the parent window, is the one that contains title bar, menu bar, tool bar, etc. The inner window, the child window, is area that is used for actual task. For example, parent window of a word processing software may contain the title bar, the menu bar, the tool bar, and the child window where users are presented with the file being edited, and can do the actual editing.

Other Components of Window Depending on the application program being used, there may be other components presented in the parent window. Many programs use the very bottom part of the window as an area to display current status of the task being performed and this is often referred to as the "status bar." Some programs have more than just one tool bar, or may have no tool bar or status bar.

1.4 Dialog Boxes

Application programs display smaller child windows from time to time to ask for user input, or offering some information. These windows are called "dialog box." Dialog box can contain one or more of the following components. These are often referred to as "controls." Note that these are most frequently used controls and there are other types of control as well.

Message Area This is where the application program displays some message to the user. The message can be some information, or instruction for the user how to provide necessary information using the dialog box.

Button Buttons are small icons which can be clicked on by pointing device. Clicking on buttons cause certain action to be performed depending on the functionalities each button is associated to. Most commonly used buttons are the "OK" button and the "Cancel" button. By clicking on the OK button, the user lets the program know that he/she understands the information provided in the dialog box and provided all the information asked for in the dialog box. By clicking the Cancel button, users can interrupt and cancel the action the program was about to perform. Dialog boxes that consist of only an OK button and a message area are often seen. In this case, the dialog box disappears as soon as the user finishes reading the message and clicks the OK button.

Edit Box Edit boxes are where users type in text information.

Read-Only Edit Box Same as edit boxes except users cannot change what is shown in this area. They are used for the same purpose as message area.

Check Box   Check boxes are small boxes often placed beside some text. Check boxes can have two states, on (checked) or off (unchecked). By clicking on them, the state can be changed from on to off or vice versa. A typical case where they are used is when users need to indicate whether they want to have certain function turned on or not, and the accompanying text describes the function.

Radio Button   Radio buttons are a group of multiple number of buttons whose purpose is to let users choose one option from multiple options. They resemble multiple check boxes, except that only one button can be checked, and one button must be checked in the case with radio buttons.

Combo Box   The purpose of combo boxes is the same as radio buttons. Only the visual aspect is the difference between the two. They are small boxes with currently selected option displayed. When a combo box is clicked on, it expands and shows other available options so that users can choose different option.

List Views   List views are often found within dialog boxes. It can, however, appear in other context as well. For example, items on the Desktop is presented in a list view.

   List views can contain various items. One of the most common purposes for using list views is to present a list of files. Users can "select" one or more items, and perform specific function on them.

Tree Views   Tree views are similar list views in concept. They are used when presenting list of items with hierarchy. For instance, table of contents of a book can be represented with a tree view. Initially, the tree view can show titles of each chapter. If user clicks on one of the chapter tiles, that item is expanded and shows list of sections within the chapter. If user happens to click on title of a section that has subsctions, the list of subsections is presented. If an expanded item is clicked on, the item collapses.

   Tree views are often used when prviding users with a mean to adjust settings for programs. In such cases, each item in the tree view is often associated with a check box. Another common usage of tree views is to present table of contents of help files.

Tabs Some dialog boxes have more than just one screen. This can be thought of as multiple sheets of paper, with each sheet of paper being a dialog box. These sheets of paper are called "tabs."

1.5   File And Related Terms

A file is a chunk of arbitrary length of electric data. Every file has a name, and users and application programs can access it using its name. It can contain any data, including, but not limited to, document, program, audio, and so on. When an application program is started, for example, a file containing the program is read by the OS, and the OS follows the instructions stored in the file and perform the tasks that are needed in order to make the application program usable by users.

Folder (Directory) Folders are used to organize files. Files are often put into different folders according to their purposes. Arbitrary number of folders can be created by users. Folder can contain files, shortcuts, and folders. Note that the term "directory" is sometimes used instead of "folder," but both of them refer to the same notion.

Disk Drive Many computers have a floppy disk drive, a hard disk drive, and a CD-ROM drive. A floppy disk is a removable medium often used to share information among different computers. The storage capacity of floppy disks is very small. The hard disk drive is often contained within the computer, and has much larger storage capacity. This is where all the programs and the Windows system are stored. Each drive has a name, called "drive letter." Usually, the floppy drive is called "drive A," and the hard disk drive is called "drive C." And often, a colon (':') is appended to the drive letter to indicate it is a drive letter, so as in "a:" and "c:." Note that when list of disk drives is shown by the Windows, each drive looks as if they are folders. And it is safe in many cases if you think of them as folders.

Shortcut A shortcut can be thought of as an alias to a file or folder. Files and folders can have as many aliases as necessary in the form of shortcuts. Shortcuts can be placed in any folder, in the Start Menu, or on the Desktop. Users are encouraged to create shortcuts to frequently accessed documents and frequently used programs and place them on a convenient location. For

sighted users, it would be on the Desktop, and for speech output users, it would be in a folder in the Start Menu. The Start Menu is actually a folder containing shortcuts to programs and more folders, so it is possible to modify it to suit the needs of individual user.

Shortcut Key   Users can assign key strokes to activate shortcuts, and these key strokes are called shortcut keys or hotkeys. Assignments of a shortcut key to a shortcut is done through the property dialog box of the target shortcut.

1.6   Use Of Pointing Device

The simplest pointing device used with the Windows OS is a mouse with two buttons. By moving the mouse, a symbol on the screen, called "mouse pointer," is moved. Action of pressing and releasing the left button on the mouse is called "click," and doing it quickly twice is called "double-click." Action of clicking right button on the mouse is called "right mouse click." When a user clicks on an icon, it means the mouse pointer is on the icon and the user clicks the left mouse button there.

Results of clicking, double-clicking, and right-clicking vary depending on the application program being used and on the context. Right-click often brings up a menu of functionalities available in that context. This menu is called "context menu." For example, if the mouse pointer is on an icon representing a file when right-clicked, actions which can be taken against that file is presented as a menu. If the same icon is clicked (with the left button), it is likely that the file is opened with an appropriate application program.

1.7   Keyboard Operation

In many situations, most of the things that can be done with pointing device can also be done with keyboard, without using pointing device. Here are some of most commonly used keyboard commands.

2   Computer Access For Visually Impaired Individuals

In order for visually impaired individuals to use computers, there are number of software and hardware developed, and these are referred to as assistive

Table 1: Keyboard Commands Available Anytime

Windows Key CTRL + ESC	Display the Start Menu
Windows Key + u	Start the utility manager
Windows key + D Windows key + M Windows key + ESC ALT + M	Go to the Desktop
Menu Key (Right Windows) Shift + F10	Display the context menu if the mouse pointer is on any object with a context menu
ALT + TAB	Change the focus to another open window

technologies. They include screen readers, screen magnification programs, and braille displays. In this part of the material, these assistive technologies are briefly explained.

2.1 Screen Readers

The very basic purpose of screen readers is to convey what is on the screen to users through speech output. Screen readers, however, do much more than merely reading the screen and below are some of key features often available in screen readers.

2.1.1 Screen Review

This is set of functionalities to allow users to find out what is displayed in any part of the screen. Review functionalities are essential since what has been spoken does not remain in the scene to be reviewed unlike information presented visually on the screen.

There are variety of functionalities for this purpose. Allowing users to use the arrow keys to explore the screen is the simplest functionality. Many screen readers provide functionalities to let users specify certain area on the

Table 2: Keyboard Commands Commonly Available Within Applications

ALT	Move the focus to the menu bar
ALT + F4	Close the window and exit the application
ALT + SPC	Call the control menu
CTRL + F4	Close the current child window
CTRL + TAB	Change to another child window
Shift + the arrow keys	Select objects
CTRL + C	Copy selected object to the clipboard
CTRL + X	Cut and move selected object to the clipboard
CTRL + V	Paste object in the clipboard to the point where the mouse pointer or the caret is
CTRL + Z	Undo the changes made immediately before pressing this key stroke
CTRL + the left/right arrow keys	Move the caret one word at a time
HOME	Move the caret to the beginning of the line
END	Move the caret to the end of the line
CTRL + HOME	Move the caret to the top of the edit window. (This often means move the caret to the beginning of the document being edited.)
CTRL + END	Move the caret to the bottom of the edit window. (This often means to move the caret to the end of the document being edited.)

Table 3: Keyboard Commands In Dialog Boxes

TAB	Move to the next control
Shift + TAB	Move to the previous control
Enter	If pressed on a button, activate the button. If pressed elsewhere, activate the default button.
SPC	If pressed on a check box, change the status of the check box. If pressed on a button, activate the button.
arrow keys	If pressed on a radio button, another button is checked. If pressed on a combo box, the down arrow expands the box, and the up and the down arrows moves through the menu items. Moving away from the combo box by TAB or Shift + TAB, or pressing the Enter key collapses the combo box and displays the newly selected menu item.
ESC	If there is a Cancel button, activate the Cancel button.
CTRL + Tab	Move to the next tab
CTRL + Shift + Tab	Move to the previous tab.

Table 4: Keyboard Commands In List Views

the arrow keys	Move to different item within the list view
any letter, numbers, punctuation keys	Move to the next item on the list whose name begins with that character

Table 5: Keyboard Commands In Tree Views

UP/DOWN arrow keys	Move up/down one item in the tree view
RIGHT arrow key	expand the item if it has any subelement
LEFT arrow key	collapse the subelements if the item has been expanded

screen, or on an application program's window and enable them to access the information presented in the area with very simple key stroke.

2.1.2   Support For Keyboard Input

According to the configuration, screen readers echo what users type in from the keyboard. Since many visually impaired users cannot look at the screen and assure that their typing is correct, this functionality is helpful, especially to beginners.

2.1.3   Mouse Emulation

Many screen readers let users use the keyboard to perform the same task as with mouse. Specifically, users can use the keyboard to move the mouse pointer and click on objects. Also, some screen readers simply make the mouse pointer follow the caret unless the user configures differently. These functionalities let users perform tasks mouse-free, and improves the productivity.

2.2   Screen Magnification Programs

Screen magnification programs allow users to enlarge text and images on the screen. Users can choose arbitrary part of the screen to be enlarged. They also let users adjust the foreground and the background colors, so that users can work with preferable color contrast.

2.3   Braille Displays

Braille displays are box with braille cells with a few keys. Most of them do not work stand-alone, they need to be connected to computers with appropriate software installed. Most screen readers have functionalities that allow users to access content of the screen through connected braille display.

Depending on product, number of braille cells differs, i.e. number of braille characters which can be displayed at once differs. Most products have between 40 and 80 cells. In general, braille displays with more cells improves the efficiency of works.

Since braille displays can show only a line or less at a time, keys on the display unit are usually configured to be used to manipulate the display.

Users can use these keys to read different parts of screen in braille. It is important to understand that what users are reading are fragments of what is on the screen and they need to re-assemble them into an image of entire screen or window. This process can be extremely difficult for some visually impaired individuals.

3 Assistive Functionalities Provided By the Windows

The Windows itself provides some assistive functionalities. Even though they are very simple and are not suitable for serious work. However, they may be sufficent for some users with very little limitation with their eyesight. Also they are useful enough for users who need to perform an initial setup of a Windows computer, such as installing a screen reader for the first time. Some of these functionalities are listed below.

3.1 Programs Included in the Windows System

Narrator – very simple screen reader, available only in English version of the Windows.

Magnifier – simple screen magnifier that provides magnified views around the mouse pointer.

Accessibility Wizard – a program to let users change various settings of the Windows to suit their needs.

Utility Manager – a simple program to let users start Narrator, Magnifier and On-Screen Keyboard.

3.2 Adjustment of the Appearance

The appearance of the screen can also be changed through the Display setting accessible through the Control Panel. To access this dialog box, do the following:

1. Open the Start Menu.

2. Chose "Settings."

3. Choose "Control Panel."

4. Choose "Display."

There are several tabs within this dialog box. The "Appearance" tab is where users can adjust the contrast and other appearance. The most important control within this tab is the "color Scheme" combo box. The display can easily be set to high contrast through this combo box.

The "Settings" tab of this dialog box has a button labeled "Advanced." Whe this button is activated, a dialog box appears where users can change the size of characters and other objects displayed on the screen. This can be changed through the combo box labeled "DPI Setting." The larger the number of the DPI setting, the larger the objects on the screen. This setting applies to most objects on the screen, unlike the settings in the appearance tab where they only apply to text.

3.3 Sounds

It may help totally blind users if the sound settings are changed so that some events trigger sound cue. This can be done through the "sSound and Multimedia" in the Control Panel. Being able to identify Events such as starting and ending programs, menu command, menu popup, etc. with sound cues can be very helpful, especially screen reader is not working properly.

4 Important Facts About Computer Access By the Visually Impaired

Aside from the fact that many visually impaired computer users cannot see the screen properly, there is two important facts which needs to be understood and kept in mind when giving instructions to them. They are:

1. They cannot have birds-eye view of the screen.

2. It is often very difficult for them to recognize dynamic changes taking place on the screen.

Assistive technologies help to overcome these facts in great extent, however, they do not eliminate these facts. Instructors need to help the users to do the following:

1. Get an idea of what is on the screen.

2. Understand the important pieces of information on the screen.

3. Find out the shortest path to get to the information users need to access.

4. Find out the shortest path to get to the places where users need to enter important information.

5. Understand the behavior of application programs so that they would know what changes on the screen to look out for.

6. Find a mean to recognize important changes on the screen.

The ultimate goal is that users can do all the above by themselves. This, however, is not easy for many users, especially for beginners. In order to help them achieve these goals, instructors need to understand application programs well enough to provide those information to users as well as understand the specific needs of the user.

5 Adjusting Windows Settings

Changing some Windows settings can often help the users. The settings below are ones that are changed often.

5.1 All Versions of Windows

These apply to all versions of Windows.

5.1.1 Showing the Favorites in the Start Menu

1. Open the Start Menu.

2. Choose "Settings."

3. Choose "Task Bar and Start Menu."

4. In the Start Menu tab, press "Customize."

5. Find the Start Menu settings tree view.

6. Find "Show Favorites" and check this option.

7. Press "OK" to leave the customize dialog.

8. Press "OK" to close the Start Menu settings dialog.

5.1.2 Disable Popups

For some users, pop-up information could be distracting.

1. Go to the Control Panel.

2. Choose "Folder Option."

3. Go to the "Advanced Settings' tree view in the "View" tab.

4. Find "Show pop-up description for folder and desktop items" and uncheck this option.

5. Press "OK."

5.1.3 Show File Extensions

In folder views, icons to indicate file types are displayed beside each filename. However, this is not so helpful if the user relies on speech output only. By showing the file extensions in the list, users can quickly identify the file type in most cases.

1. Go to the Control Panel.

2. Choose "Folder Option."

3. Go to the "Advanced Settings' tree view in the "View" tab.

4. Find "Hide extension for known file types" and uncheck this option.

5. Press "OK."

5.2 Windows XP

The Windows XP system has different appearance from previous versions of Windows. However, many people prefer to use the older appearance, as it is simpler in many ways, and thus easier to understand and navigate. This sections shows how the appearance of Windows XP can be changed.

5.2.1 Start Menu

XP systems have different Start Menu. To make it similar to Windows 95/998/2000, do the following:

1. Right-click on the Start button, or open the Start Menu and hit ESC, and hit the application key (or Shift + F10).

2. Choose "Property."

3. In the "Start Menu" tab, choose "Classic Start Menu."

4. Press "Customize."

5. In the "Advanced Start Menu" tree view, find "Use Personalized Menus" and uncheck this item.

6. Press "OK" to close the "Customize" dialog box.

7. Press "OK" to close the property.

5.2.2 Folder View

Do the following to adjust the appearance of the folder view to the classic view.

1. Go to the Control Panel.

2. Select "Folder Option."

3. At the first control of the first tab, select "Use Windows Classic Folders."

4. Press "OK."

5.2.3 Color Scheme

Do the following to adjust the color scheme to the classic view.

1. Go to the Control Panel.

2. Choose "Display."

3. In the combo box labeled "Theme," choose "Windows Classic."

4. Press "OK."

6 JAWS Basics

JAWS for Windows developed by Freedom Scientific is one of the most widely used screen readers in Euro-language speaking countries. In this section, key concepts required to understand the operation of JAWS for Windows are introduced. Other screen reading products also employ similar concepts, thus understanding those in JAWS should help understanding other products as well.

6.1 The JAWS Help System

You can access the entire documentation on JAWS from the Help menu in the JAWS window, or from the context menu which is opened as you do INS + J. The help documents explain all the concepts and details of JAWS commands and can be used as the reference document.

Another way to access the help system is to press INS + F1. Pressing this key combination once shows a brief help, and if it is pressed twice quickly in succession, you are taken to the part of the help document that explains how to use JAWS in conjunction with the application program you are currently using.

Another tool to aid you when you use JAWS is the keyboard help mode, which can be turned on and off by pressing INS + 1 (1 in the number row, not in the number pad.) When keys are pressed within the keyboard help mode, the functionality assigned to the keystroke is announced. If the same key combination is pressed twice quickly, detailed information on the functionality is provided.

6.2 Different Types of Cursor in JAWS

In order to use JAWS, users must understand the concepts of three different types of cursor which are explained briefly below.

6.2.1 PC Cursor

The PC cursor is the cursor, or the caret, on the screen. When PC cursor is active in JAWS, pressing arrow keys moves the caret on the screen. When PC cursor is active, users cannot go to any part of the screen where the caret cannotbe placed. For example, users cannot use the PC cursor to go up and read the title bar. This, however, is most commonly used cursor, and is sufficent in most tasks.

6.2.2 JAWS Cursor

JAWS cursor is linked to the mouse pointer. When the JAWS cursor is active in JAWS, preesing arrow keys causes the mouse pointer to move, and at the same time, the part where the mouse pointer is moved to is read by JAWS.

The primary purpose of the JAWS cursor it to allow users to read part of the screen where the PC cursor cannot go to. This sometimes helps users to have a good understanding of how things are laid out in the window. At the same time, it can be used to emulate mouse operations. For example, when there is a button that cannot be activated by any keyboard operation, users can find it by moving the JAWS cursor, and click on the button using the mouse button emulation keys. The mouse emulation keys are the "/" and the "*" keys on the numpad, and they are equivalent to let mouse button and right mouse button respectively.

When the JAWS cursor is active, users must keep in mind that pressing the arrow keys does not affect the caret on the screen. Thus, it is not possible to select, and cut/copy and paste using the shift key and the arrow keys when the JAWS cursor is active.

6.2.3 Virtual PC Cursor

The Virtual PC cursor is similar to the PC cursor except that the caret is not affected by key press. This mode is availble in several specific application programs, and the Internet Explorer is probably the most commonly used

application amongst them. Another such application program is the help file viewer.

When Internet Explorer is started, the Virtual PC cursor becomes active. In this mode, users can use the arrow keys to read through the document opened by the Internet Explorer, even though the caret on the screen does not move. Users can select, and cut/copy and paste using the shift key and the arrow keys just as in the PC cursor mode.

A very important thing for both users and instructors to remember is that even when reading through a page using the down arrow key, it doesn't necessarily mean that what seems to be one line on the screen is read at once. One press of the down arrow could read just a part of a line, or several lines at once. How much information is read by one press of down or up arrow key depends on how the page is written in HTML. Without remembering this, users may get a wrong impression that all the Web pages on the net looks quite tall and narrow.

7 Braille Transcribing System

Computers can be very helpful in producing braille materials. Most electric data, such as document prepared with word processing software for inkprint, information available on the Internet, etc., can be translated into braille and embossed by braille embossers. Printed materials can also be scanned using scanner and converted into text using OCR (optical character recognition) software, and translated into braille, if the print is clear and the layout is not so complex. Using such system can be extremely helpful when the volume of the material is large, or many copies are needed. This part of the presentation provides the basics of the braille as well as brief description of braille transcribing system.

7.1 The Basics Of Braille And Computer Braille

7.1.1 The Six-Dot System

Each column (or cell) in braille text consists of up to six dots. The six dots are arranged in two vertical lines, each of which is made up by three dots, placed side by side. The dots are numbered from the left top to the bottom, then right top to the bottom from 1 to 6. So on the left-hand side, the dots are from the top to the bottom, 1, 2, and 3, and on the right-hand side,

the dots are from the top to the bottom, 4, 5, and 6. In many cases, one column represents one character, but there are often cases where more than two columns are used to represent one character.

The same 6 dot system is used across many different languages. It is very important to understand that the same dot pattern represents totally different character depending on the language.

7.1.2 Contractions

In many languages, there are certain form of contracted braille. The original purpose for the contracted braille was to reduce the volume of braille material as well as to raise the reading speed. For example, in English, the word "the" can be represented by dots 2, 3, 4, and 6. There are many more contraction for frequently used words and letter combinations.

7.1.3 Computer Braille

The basic purpose of computer braille is to provide representation of signs used on computer screens but not so frequently in conventional braille. There are a few variants of so called computer braille. The most widely used computer braille is one used in the North America, and is called North American Braille Computer Code (NABCC.) The NABCC and the European braille code are both designed so that every character only requires one column to be represented. This is very useful when braille displays are in use since the layout on the screen can be preserved and conveyed to users much better. For example, numbers must be preceded by the number sign and uppercase letters must be preceded by the capital sign in conventional braille. In the NABCC and the European computer braille, however, they only take up one column. In order to make this possible, instead of conventional 6 dot system, 8 dot system is used. Two dots were added below the conventional 6 dot column. When referring to these added dots, the dot below the dot 3 is called the dot 7, and the dot below the dot 6 is called the dot 8. In the NABCC, the dot 7 is added to all the alphabet to represent uppercase letters, and lowered numbers are used to represent numbers. (See the table below.)

One notable thing about the NABCC is that all the 64 combinations, which is possible with 6 dot system, are used. Each combination represents one unique character. Note that the 64 combinations do include the space character, but do not include any character with the dot 7 as shown in the

Table 6: Characters In the NABCC Without the Dot Seven

symbol	dots	symbol	dots	symbol	dots
!	2-3-4-6	6	2-3-5	j	2-4-5
"	5	7	2-3-5-6	k	1-3
#	3-4-5-6	8	2-3-6	l	1-2-3
$	1-2-4-6	9	3-5	m	1-3-4
%	1-4-6	:	1-5-6	n	1-3-4-5
&	1-2-3-4-6	;	5-6	o	1-3-5
'	3	¡	1-2-6	p	1-2-3-4
(	1-2-3-5-6	=	1-2-3-4-5-6	q	1-2-3-4-5
)	2-3-4-5-6	¿	3-4-5	r	1-2-3-5
*	1-6	?	1-4-5-6	s	2-3-4
+	3-4-6	_	4-5-6	t	2-3-4-5
,	6	'	4	u	1-3-6
-	3-6	a	1	v	1-2-3-6
.	4-6	b	1-2	w	2-4-5-6
/	3-4	c	1-4	x	1-3-4-6
0	3-5-6	d	1-4-5	y	1-3-4-5-6
1	2	e	1-5	z	1-3-5-6
2	2-3	f	1-2-4	{	2-4-6
3	2-5	g	1-2-4-5	—	1-2-5-6
4	2-5-6	h	1-2-5	}	1-2-4-5-6
5	2-6	i	2-4	~	4-5

table below.

This means that any text that can be represented in 6-dot braille system can be represented using the NABCC. So most, if not all, braille displays and braille embossers understand the NABCC. Therefore, braille translation software take electric data in other formats and convert it into the NABCC so that it can be sent to braille embossers. Note that what is displaed on the screen, and read by screen readers, when editing braille documents within braille translation software are symbols representing characters in the NABCC, so they do not make much sense.

Table 7: The NABCC Characters With the Dot Seven (Excluding Uppercase Alphabet)

symbol	dots	symbol	dots
@	4-7	]	1-2-4-5-6-7
[	2-4-6-7	^	4-5-7
\	1-2-5-6-7		

Table 8: Commonly Used And Stable Serial Settings

communication speed (baud rate)	9600
parity	none
bit length	8
stop bit	1
handshake	software handshake

7.2   Braille Embosser

As described above, braille embossers understand the NABCC. They can be connected to computers via either the serial port, the parallel port, or the USB port. Most braille embossers have both the serial and the parallel ports. Only newer embossers have the USB port. While use of the USB port is encouraged for variety of reasons, it is also true that older computers do not have the USB port.

When there is no USB port, the serial port is used more often than the parallel port since the parallel port is usually occupied by the ink printer. While using the parallel port does not require the settings described below, it often requires more complicated settings modification, specifically in the BIOS menu.

To connect embossers using a serial connection, serial settings of both devices, the computer and the embosser, must agree with each other. The following table shows the most commonly used, and recommended settings.

A   Important Key Strokes

Table 9: Important Key Strokes Of JAWS

INS + 1 on the number row	Keyboard help
INS + F1	JAWS help
INS + T	Window title
INS + J	JAWS menu or JAWS window

Table 10: Important Key Strokes Of the Duxbury System

CTRL + O	Open file
CTRL + T	translate current document into braille
CTRL + P	create the inkprint of the document
CTRL + E	emboss the braille document

B   Assistive Vendor Contact Information

Freedom Scientific	Address	11800 31st Court North
		St. Petersburg, FL
		33716-1805 USA
	Phone	+1-727-803-8000
	Fax	+1-727-803-8001
	Web	`http://www.freedomscientific.com/`
GW Micro, Inc.	Address	725 Airport North Office Park
		Fort Wayne, IN
		46825 USA
	Phone	+1-260-489-3671
	Fax	+1-260-489-2608
	Web	`http://www.gwmicro.com/`
Ai Squared	Address	P.O. Box 669
		Manchester Center, VT
		05255 USA
	Phone	+1-802-362-3612
	Fax	+1-802-362-1670
	Web	`http://www.aisquared.com/`
Duxbury Systems	Address	270 Littleton Rd., Unit 6
		Westford, MA
		01886 USA
	Phone	+1-978-692-3000
	Fax	+1-978-692-7912
	Web	`http://www.duxsys.com/`
Dolphin Computer Access	Address	Technology House
		Blackpole Estate West
		Worcester
		WR3 8TJ United Kingdom
	Phone	+44 (0) 1905 754 577
	Fax	+44 (0) 1905 754 559
	Web	`http://www.dolphinuk.co.uk/`

C Assistive Software Information

(The prices shown are in the U.S. dollar.)

Vendor	Product	Features	Platform	Price
Freedom Scientific	JAWS Standard	screen reader	Windows 95/98/ ME/ XP Home	$895
	JAWS Professional	screen reader	Windows NT/ 2000Pro/ XP Pro/ 95/ 98/ ME/ XP Home	$1,095
	MAGic Standard with Speech	screen magnification with speech	Windows 95/ 98/ ME/ XP Home	$545
	MAGic Standard without Speech	screen magnification	Windows 95/ 98/ ME/ XP Home	$295
	MAGic Professional with Speech	screen magnification with speech	Windows 95/ 98/ ME/ NT/ 2000/ XP Pro	$595
	MAGic Professional without Speech	screen magnification without speech	Windows 95/ 98/ ME/ NT/ 2000/ XP Pro	$395
GW Micro	Window-Eyes Professional	screen reader	Windows 95/ 98/ ME/ 2000/ XP	$795
	Window-Eyes Standard	screen reader	Windows 95/ 98/ ME	$595
Dolphin Computer Access	Supernova Pro	screen reader, magnification, with additional features	all Windows	$1,395
	Supernova Std	screen reader, magnification	all Windows	$995
	HAL Pro	screen reader with additional features	all Windows	$1,095
	HAL Std	screen reader	all Windows	$695
	LunarPlus	screen magnification with speech	all Windows	$595
	Lunar	screen magnification	all Windows	$395
Ai Squared	ZoomText Xtra Level 1	screen magnification	all Windows	$395
	ZoomText Xtra Level 2	screen magnification, screen reader	all Windows	$595
Duxbury Systems	DBT Win	Braille translation	all Windows	$595

D Web Accessibility and Other Resources

World Wide Web Consortium (W3C)	http://www.w3.org/
Web Accessibility Initiative (WAI)	http://www.w3.org/WAI/
CSUN	http://www.csun.edu/cod/