

WORKING TOGETHER: Computer Technology and People with Mobility & Sensory Impairments

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HOW CAN TECHNOLOGY HELP?

While it is helpful to recognize the specific limitations of an individual, it is more important to focus on the task to be completed and how his abilities, perhaps assisted with technology, can be used to accomplish the goal or task. Specific accommodations can then be explored that provide access to software or to a specific device such as a keyboard or mouse.

This list is not exhaustive; people with disabilities, parents, teachers and adaptive technology practitioners should consider other approaches as well. New hardware and software is constantly under development and promises to continually improve access options. Additionally, many successful accommodations have been made using homemade or other low-tech materials. Following are descriptions of some computing tools that have been used effectively by individuals with disabilities.

MOBILITY IMPAIRMENTS

The specific impact of a mobility impairment and the resulting need for adaptive technology are unique to each individual. The impact of a disability may be mild or severe in how it affects an individual's ability to access a computer.

Keyboard Access

The keyboard can be the biggest obstacle to computing for a person with a mobility impairment.

People with disabilities meet all types of barriers to their independence. However, technology is helping to lower many of these barriers. Computing technology for tasks such as reading, writing, communicating and searching for information on the Internet is helping many people with disabilities gain greater independence.



Kensington's Trackball

Fortunately, those who lack the dexterity or range of motion necessary to operate a standard keyboard have a wide range of options from which to choose. Pointers can be held in the mouth or mounted to a hat or other headgear and used to press keys on a standard keyboard. Repositioning the keyboard to the floor can allow someone to use his feet instead of his hands for typing.

Before purchasing a complex keyboard option, it is a good idea to evaluate the accessibility features that are built-in on current popular operating

systems. For instance, the Accessibility Options control panel in current versions of Microsoft Windows™ contains a variety of settings that can make a standard keyboard easier to use:

- For a person who has a single point of entry (a single finger or mouth-stick), use of StickyKeys allows keystrokes that are usually entered simultaneously, such as Ctrl-key shortcuts found in menus, to be entered sequentially.
- FilterKeys can eliminate repeated keystrokes for a person who tends to keep a key pressed down too long. Check the Settings menu for these features and experiment with different time delays for optimum effect. The Macintosh operating systems have similar features in the Easy Access control panel.
- Consider using the features common in popular word processor programs, such as Microsoft Word™, to ease text entry. The AutoCorrect™



TechAble Keyboard

feature of Word allows sentences or blocks of text, such as an address, to be represented by unique and brief letter sequences. For example, entering “myaddr” could be set to automatically display one’s address in proper format. Long words can be abbreviated and entered into the AutoCorrect settings to increase typing speed and accuracy.

Keyguards

A keyguard is a plastic or metal shield that fits over a standard keyboard. Holes are drilled into the guard to help an individual with poor dexterity or hand control press only the desired key without inadvertently pressing other keys. Keyguards are available from a variety of manufacturers (e.g., Don Johnston, TechAble).

Alternative keyboards

Alternative keyboards can be considered for a person who cannot effectively operate a regular keyboard. Keyboards can be smaller (e.g. Tash’s MiniKeyboard™) for people who have limited range of motion, or larger for a person has good range of motion and poor dexterity. Several vendors offer an array of alternative keyboards to accommodate a variety of limitations (e.g., Infogrip).

If physically activating a keyboard—whether through changing the settings or switching to an alternative keyboard—is not possible, think about a virtual keyboard. A virtual keyboard appears on the computer screen as a picture of a keyboard. A mouse, trackball or alternative point-

ing system activates the keys on the screen and inserts the appropriate keystrokes into the desired program. A person can enter text by clicking on specific keys on the keyboard image. Modifier keys such as Ctrl and Alt can also be accessed, as can the function keys. Some virtual keyboards incorporate word prediction (see below) to increase entry speed and may include alternate layouts in addition to the traditional “QWERTY” layout found on standard keyboards.

Word Prediction

Typing words correctly and quickly can be a challenge for some people with mobility impairments. Word prediction programs prompt the user with a list of likely word choices based upon words previously typed. Some word prediction software automatically collects new words as they are used, and consider a person’s common vocabulary when predicting in the future. Word prediction is often used with a virtual keyboard to increase accuracy and typing speed.

Alternative Pointing Systems

With the advent of graphically-oriented operating systems, it is vital to have



Freedom Scientific's MAGic™ Software

access to a mouse or an alternative pointing device. For those who lack the coordination to use a standard mouse, there are many alternatives to consider. Trackballs are a good first choice; the control surface can be eas-

ier to manipulate and the buttons can be activated without affecting the pointer position. Some trackballs (e.g., Kensington) offer additional buttons that add functionality such as double-clicking, click and hold, and other commands, and can be pro-



The HeadMouse™ mounted on an Apple iBook™

grammed to a person’s specific needs.

Other alternative pointers can be found in many mainstream computer stores and supply catalogs. External touchpads, similar to those built into many notebook computers, offer an ideal pointing system for some. Handheld pointing devices such as the ProPoint™ (Interlink Electronics) with a small control surface area may be useful for someone with very limited hand mobility. For people with mobility impairments who already use a joystick to drive a wheelchair, a device such as the Roller Joystick™ (Penny & Giles) may be an excellent choice.

A person with good head control who cannot control a mouse or alternative pointing device with any limb should consider using a head-controlled pointing system such as HeadMouse™ (Origin Instruments) or HeadMaster™ (Prentke Romich). These head-controlled pointing systems use infrared detection and a transmitter or reflector that is worn on the user’s head and translates head movements into mouse pointer movement on the computer screen. Use of

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RESOURCES

Ai Squared

P.O. Box 669,
Manchester Center, VT
05255
Phone: (802) 362-3612,
Website:
<http://www.aisquared.com>

Alva Access Group

436 14th Street
Suite 700
Oakland CA 94612
Phone: (888)318-ALVA
(2582)
Website:
<http://www.aagi.com>

Arkenstone

Freedom Scientific's
Learning Systems Group
480 California Avenue
Suite 201
Palo Alto, CA 94306-1609
Phone: (888) 223-3344
(650) 475-5435
*(Formerly known as
Arkenstone, the association
is now part of Freedom
Scientific's Learning Systems
Group. More information
can be found by visiting the
Freedom Scientific Website.)*

**Artic Technologies - Simply
Computers**

1000 John R. Road
Suite 108
Troy, Michigan 48083
Phone:(248) 588-7370
Website:
<http://www.artictech.com>

Dolphin Access Systems

60 East Third Avenue,
Suite 130
San Mateo, CA 94401USA
Phone: (866) 797 5921
Website:
<http://www.dolphinusa.com>

Don Johnston, Inc.

26799 West Commerce Dr.
Volo, IL 60073
Phone: (800)999-4660
(US & Canada)
(840)740-0749
(US & Int'l)
Website:
<http://www.donjohnston.com>

Dragon Systems

ScanSoft, Inc.
9 Centennial Drive
Peabody, MA 01960
Phone: (800) 654-1187
(USA) (978) 977-2452 (Int'l)
Website:
<http://www.dragonsys.com>
<http://www.scansoft.com>

Freedom Scientific

11800 31st Court North
St. Petersburg, FL
33716-1805
Phone: 800-444-4443
(within US)
727-803-8000
(worldwide)
Website:<http://www.freedomsscientific.com>

GW Micro, Inc.

725 Airport North Office Park
Fort Wayne, IN 46825 USA
Phone: (260)489-3671
Web Page:
<http://www.gwmicro.com>

IBM Corporation

IBM Accessibility Center
11400 Burnet Road,
Austin, TX 78758
Phone: (800) 426-4832
Website:<http://www-3.ibm.com/able/>

Infogrip, Inc.

1794 E. Main Street
Ventura, CA 93001
Phone: (800) 397-0921
(805)-652-0770
Website:
<http://www.infogrip.com>

Inspiration Software, Inc.

7412 SW Beaverton
Hillsdale Hwy
Portland, OR 97225-2167
Phone: (800) 877-4292
Website:
<http://www.inspiration.com>

Intellitools, Inc.

1720 Corporate Circle
Petaluma, CA 94954-6924
Phone: (800) 899-6687 (USA)
(800) 353-1107 (Canada)
(707) 773-2000 (Global)
Website:
<http://www.intellitools.com>

Interlink Electronics, Inc.

546 Flynn Road
Camarillo, CA 93012
Phone: (800) 340-1331
Website:
<http://www.interlinkelectronics.com>

Kensington Technology Group

Corporate Headquarters
2000 Alameda de las Pulgas
Second Floor
San Mateo, California
94403-1289
Phone:(800)235-6708
(North America)
(650)572-2700
(Outside North America)
Website:
<http://www.kensington.com>

**Kurzweil Educational
Systems, Inc.**

14 Crosby Drive
Bedford, MA 01730-1402
Phone:(800) 894-5374
(USA or Canada)
(781) 276-0600
(other countries)
Website:
<http://www.kurzweiledu.com>

Lernout &Hauspie

*Now part of ScanSoft, Inc.
For more information, see
the contact information for
Dragon Systems/ScanSoft.*

**Next Generation
Technologies**

20006 Cedar Valley Rd
Suite 101
Lynnwood, WA 98036-6334
Phone: (425) 744-1100
Website:
<http://www.ngtvoice.com>

**Origin Instruments
Corporation**

854 Greenview Drive
Grand Prairie, TX
75050-2438
USA
Phone: (972) 606-8740
Website:
<http://orin.com/index.htm>

Papenmeier

F.H. Papenmeier GmbH
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P.O. Box 1620
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Schwerte, Germany
Phone: +49-2304-205-0,
Website:
<http://www.papenmeier.de/>

**Penny & Giles
Computer Products**

1 Embankment Way
Castleman Industrial Estate
RINGWOOD
Hampshire
BH24 1EU
United Kingdom
Phone:+44 (0)-1-425-463100
Website: <http://www.penny-gilescp.co.uk/>

Prentke Romich Company

1022 Heyl Road
Wooster, OH 44691
Phone: (800) 262-1933
Website:
<http://www.prentrom.com/>
<http://www.prentromint.com>
(outside US)

Tash Inc.

3512 Mayland Ct.
Richmond VA 23233
Phone; (800)463-5685
Website:
<http://www.tashinc.com>

TechAble

1114 Brett Drive
Conyers, GA 30094
Phone: (770)922-6768
WebSite:www.techable.org

equipment shop

new england village

Circle #36 or visit www.eparent.com/adinfo

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an additional switch (see Switch Access below) replaces the mouse button. Combining a head pointing system with an on-screen keyboard allows full computer control to someone who cannot use a standard keyboard and mouse.



Infogrip's Discover:Board™

Switch Keyboard and Mouse Access Using Scanning or Morse Code

When a person's mobility impairment prevents the use of a standard keyboard or mouse, using a switch may be a possibility. Switches come in a wide array of styles and can be controlled with nearly any body part. Switches can be activated with a kick, swipe of the hand, sip and puff by mouth, head movement, eyeblink or touch. Even physical closeness can activate a proximity switch. These switches work in concert with a box or emulator that sends commands for the keyboard and/or mouse to the computer.

There are a variety of input methods that rely on switches. Scanning and Morse code are two of the most popular. Upon activation of a switch, scanning will bring up a main menu of options on the screen. Additional switch activations allow menu items to be narrowed down to the desired keystroke, mouse or menu action. Morse code is a more direct method of control than scanning and, with practice, can be a very efficient input method. Most learners quickly adapt to using Morse code and can achieve high entry speeds.

Switch systems should be mounted with the assistance of a knowledgeable professional, such as an occupational therapist. If mounted to a wheelchair, it is important that switch mounting does not interfere with wheelchair controls. Seating and positioning specialists can also help determine optimum placement for switches, reduce the time in discovering the best switch system and maximize positive outcomes.

Speech Recognition

Speech recognition software converts words spoken into a microphone to machine-readable format. The user speaks into the microphone either with pauses between words (discrete speech) or in a normal talking manner (continuous speech). The discrete speech system, although slower, allows the user to identify errors as they

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occur. In continuous speech systems, corrections are made after the user is finished speaking. Speech recognition technology requires that the user have moderately good reading comprehension in order to correct the program's text output. Voice and breath stamina should also be a consideration when evaluating speech recognition as an input option.

Reading Systems

An individual who has a difficult time holding printed material or turning pages may benefit from a reading system. These systems are typically made up of hardware (scanner, computer, monitor, and sound card), Optical Character Recognition (OCR) software (e.g., Arkenstone's WYNN or Kurzweil 3000), and a reading/filing program. The system provides an alternative to reading printed text. Hard copy text is placed on the scanner where it is converted into a digital image. The image is then converted to a text file, making the characters recognizable by the computer. The computer can then read the words back using a speech synthesizer and simultaneously present the words on screen.

Low-Tech Tools

Not all assistive technology for people with mobility impairments is computer-based. The use of such common items as adhesive Velcro to mount switches or power controls can provide simple solutions to computer access barriers. Often, tools of one's own making can provide the most effective and comfortable accommodations for mobility impairments.

SENSORY IMPAIRMENTS

As computers and operating systems have become increasingly sophisticated, adapting computers for use by people with sensory impairments has posed increasing challenges. Because sound was rarely used, people with hearing impairments experienced few limitations in operating the early personal computers. Not long after the introduction of the personal computer, software and hardware systems for reading screen text out loud were developed for people with visual impairments.

The advent of graphical interfaces (e.g., Microsoft Windows™ and Macintosh OS™) complicates computer access for people who cannot see the screen, since their speech output systems are designed to read text. Multimedia output that uses audio is not accessible to

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those people who cannot hear and people who cannot feel a keyboard cannot type effectively. Fortunately, specialized hardware and software can make computer systems usable by individuals with a sensory impairment.

VISUAL IMPAIRMENTS

The most common accommodation for a computer user with a visual impairment is to enlarge the display of a monitor. This is accomplished using screen enlargement software. Various screen enlargement packages offer a variety of features. The most popular features enlarge the display from two to 16 times the normal view and invert

screen colors for those who are sensitive to the usual display of white text on a black background. Some enlargers also incorporate speech output to reduce the strain associated with reading large blocks of text. Commonly used enlargement software includes ZoomText Xtra™ (Ai Squared), Magnum™ (Artic), MAGic™ (Freedom Scientific), and Lunar™ (Dolphin Access Systems).

Screen enlargement technology combined with a scanner can be used to magnify printed text. Once a page is scanned using a standard desktop scanner, the results are displayed in large print on the computer screen.

People who are blind access com-

puter output with speech and/or Braille output systems. Speech output is the most popular form of access. A variety of products have been created for working with the Microsoft Windows™ operating system. Most people who are blind use a standard keyboard as an input device, since using a mouse pointer requires accurate eye-hand coordination. Screen reader software uses pre-defined key combinations for review and navigation of the computer screen and is usually compatible with most standard software, including word processing, Web browsing and electronic mail. Examples include, but are not limited to, HAL™ and SuperNova™ (Dolphin Access Systems), JAWS™ for Windows (Freedom Scientific), outSPOKEN™ (Alva Access Group), and Window-Eyes™ (GW Micro). People who are blind using a Macintosh are limited to outSPOKEN™.

Refreshable Braille displays are devices that echo information from the screen to a panel with Braille cells. Within the cells are pins that move up or down based on the text transmitted. Braille displays can provide very effective accommodations for users who require precise navigation and editing, such as when creating computer program code that isn't pronounced well with speech. Displays such as the BRAILLEX™ (Papenmeier) and Delphi™ (Alva Access Group) also provide navigation and orientation information to the computer user who is blind.

For novice screen reader users who need access to the World Wide Web, consider dedicated Web browsing software that incorporates speech and/or large print. These browsers ease the process of navigating complicated Web sites, and simplify Web

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searching as well as reading of Web sites. Home Page Reader™ (IBM) and Connect Outloud™ (Freedom Scientific) are two of the many examples of this kind of software.

HEARING IMPAIRMENTS

There are few adaptations available (or necessary) for people with hearing impairments using standard computer productivity software. Sound is used little in mainstream applications such as word processing or e-mail and, when it is used, there is often a visual alternative. Built-in operating system features found in the control panels of Windows software and the Macintosh computer provide visual displays for system-generated beeps.

The increasing use of streaming multimedia is a concern for those who can not hear. Content developers rarely include captioning in video presentations, nor do they transcribe the audio into text. Resources from the National Center for Accessible Media (NCAM) and Microsoft are available for content developers to add captioning to streaming video.

LIMITED SENSITIVITY

Loss of sensitivity in hands and/or fingers due to peripheral neuropathy or other causes can make it difficult or impossible to use a standard keyboard and mouse. People with this type of sensory impairment can benefit from the use of speech input software such as NaturallySpeaking™ (Dragon Systems) or Voice Xpress™ (Lernout & Hauspie) to control a computer and enter text. Because Neuropathy may be accompanied with vision loss, use of speech output may also be required. JawBone™ (Next Generation Technologies) is middleware—software that serves as a go-between for

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two other programs—that allows JAWS screen reading software to work with Dragon NaturallySpeaking.

EMPOWERING THE USER

It is important to remember that the specific need for adaptive technology is unique to the individual. Trial-and-error may be required to find a set of appropriate tools and techniques. The end user—the person with a disability—should play a key role in determining what works best. **EP**

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About DO-IT

DO-IT (Disabilities, Opportunities, Internetworking and Technology) serves to increase the participation of individuals with disabilities in challenging academic programs and careers. It promotes the use of computer and networking technologies to increase independence, productivity and participation in education and employment. For further information, contact:

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