Considerations in the Design of Computers to Increase Their Accessibility by Persons with Disabilities

Version 4.2 May, 1988

Introduction

This document has been prepared by the Design Considerations Task force of the Industry/Government Cooperative Initiative on Computer Accessibility. It is designed to be purely informational in nature, and has been developed at industry's request, to facilitate their efforts in this area. It represents the compilation of information from many sources and, as a working document, is under continual revision. No endorsement of the contents by any particular group should be inferred.

Background on the Industry/Government Initiative

In 1984, the Office of Special Education and Rehabilitation Services (U.S. Department of Education), in conjunction with the White House, took the initiative to begin a process of bringing computer manufacturers, developers and consumers together to address the question of access and use of standard computer and computer software by persons who have disabilities.

The first meeting of the initiative was held on February 24, 1984 at the White House. The objective of the first meeting was to familiarize the companies with the problem and to solicit their support for a cooperative effort to address the problem. The result of the first meeting was a recognition of the problem, and a request by the manufacturers for more information about the types of disabilities, the resulting barriers to the use of standard computers, and the types and scope of the solution strategies that the manufacturers were being asked to consider.

Subsequent to the meeting in February at the White House, briefings were held with manufacturers, and a White Paper was developed, distributed for comment, and revised and distributed in preparation for a second meeting held on October 24-25, 1985. This meeting consisted of a one and one-half day work session followed by a reporting session at the Rayburn Building on Capitol Hill. Computer firms represented included Apple, AT&T, Digital Equipment Corp., Hewlett Packard, Honeywell, IBM, and Tandy (Radio Shack).

One of the four results of this meeting in October was the formation of a task force to identify, refine, and document ideas and considerations for the design of standard computers to increase their accessibility by disabled and non-disabled people. This group is open to any researchers, manufacturers, and consumers who want to work with this group. The objective of this cooperative industry-rehabilitation group is to develop materials for industry that can be used to improve the design of computers so that they will be usable by a larger portion of the population. The primary focus of this task force is the development of the design information to increase accessibility. This includes information regarding the disabilities, their impact, the specific problems currently encountered, future anticipated problem areas, and existing or suggested design strategies as they are identified.

The overall computer access effort is being coordinated by the Electronic Industries Foundation and the Trace Center at the University of Wisconsin-Madison and is supported by grants G008300045 and G0083C0020 of NIDRR (OSERS - Department of Education). The task force (of the Industry/Government Committee) is being coordinated out of the Trace Center. Membership in the task force is open to anyone who would like to participate. All task force work is done via mail to maximize participation by all interested parties. You may become a task force member simply by dropping a note to the task force, care of the Trace Center, S-151 Waisman Center, 1500 Highland Avenue, Madison WI 53705.

Overview

A significant portion of our population has disabilities (acquired at birth or through accident, illness or natural aging) which prevent them from using standard microcomputers and software.

Many low-cost and no-cost modifications to computers would greatly increase the number of individuals who could use standard computers without requiring modifications.In addition, other modifications would greatly increase the ability to attach special input and output systems, further increasing the number of individuals who can access and use standard computers and software (as well as lowering the cost for such modifications).

Most of these design changes fall in the low-cost or no-cost range, and have direct benefit to the mass market as well. The current direction in which computer systems are evolving will automatically encompass many or most of the required features and capabilities if the new design directions are implemented carefully.

In discussions with engineers and designers within the major computer companies, the predominant response has been that many of the desired changes could have been included in the design of computers originally if the developers had been aware of the need for and impact of such changes. The purpose of this Design Considerations document is to provide an awareness of the different types of problems, as well as design recommendations for increasing the accessibility of new computers.

Disability Types and Barriers

Physically impaired individuals face their primary difficulty in using the computer's input devices, or in handling storage media. Individuals in this group include individuals with congenital disabilities, spinal cord injuries, and progressive diseases, as well as individuals who are without the use of just a hand or arm. Adding some options to the keyboard handling routines would allow many individuals to use the keyboard. Providing means to connect "alternate keyboards" would provide access for individuals who have more severe disabilities.

Visually impaired individuals have their primary difficulties with the output display, although newer display-based input systems (e.g., mice, touchscreens) may also pose problems. This group includes individuals who have failing vision and individuals with partial vision, as well as those who are blind. The primary solution strategies involve providing a mechanism to connect alternate display or display translator devices to the computer, and providing alternatives to display-based input.

Hearing impaired and deaf individuals currently have little difficulty in using computers. Visual redundancy of auditory clicks and tones would be helpful. The primary concern is ensuring that future voice output information is provided in a redundant form that hearing impaired or deaf individuals can also understand.

Cognitively impaired individuals have their greatest difficulties in dealing with the software itself, although layout and labeling of operational controls can also effect their ability to use computers. Cognitive impairments can take many forms, including retardation, short- or long-term memory impairments, perceptual differences, learning disabilities, and language impairments. Of particular concern are computer, information or transaction systems which are intended for public use. Proper design of these systems can greatly increase the number of individuals with mild cognitive impairments who could use the systems -- although these systems may not be operable by individuals with severe impairments. Solution strategies in this area would be more general in nature, and revolve around such objectives as simplification of displays and legends, minimization of language level.

Design Considerations for Individuals with Moderate Physical Impairments

Physically disabled individuals face their primary difficulty in using the computer's input devices, or in handling storage media. People in this group include persons with congenital disabilities, spinal cord injuries, and progressive diseases, as well as people who are without the use of just a hand or arm. Adding some options to the keyboard handling routines would allow many individuals to directly access the computer.

PROBLEM DEFINITION

Some individuals who can use only one arm or hand (temporarily or permanently) or who use a headstick or mouthstick cannot activate multiple buttons or keys at the same time.

Examples

Individuals with one arm or those who use a mouthstick cannot useshift/control/option keys on standard keyboards. . . . . or operate a mouse while they hold down a shift/control/option key. . .. . . or operate a multi-button mouse.

DESIGN RECOMMENDATION:

Input devices that require multiple simultaneous activations should have an optional (sequential) mode of operation. This mode should be available at any time, and should eliminate the need for simultaneous actions.

PRIORITY: 1st RECOMMENDED EXCEPTIONS:

1. Input buttons/keys requiring co-activation for physical safety reasons;

2. Input buttons/keys not required for normal operation

Current GSA Guideline

"Multiple Keystroke Control. Currently there are numerous common functions on the computer that require multiple, simultaneous keystrokes (e.g., to reboot CTRL+ALT+DEL must all be depressed at the same time). Multiple keystroke control would enable the user to execute a sequential option in which multiple keystrokes could be entered serially (e.g. to reboot a user could depress CTRL, then ALT, then DEL)." (Current GSA - Initial Guidelines, October, 1987)

NOTES

1. This is the only major computer access barrier faced by many individuals with mild to moderate handicapping conditions (such as many with spinal cord injuries), and one which can be easily addressed.
2. This feature applies to input devices and controls needed for computer operation only, and is not meant to apply to periodic adjustment, maintenance, set-up, or materials replacement aspects of the equipment, such as changing ribbons or paper, removing jams, etc., although these capabilities are also useful.
3. A "Sticky Key" feature could be added to the keyboard to solve this problem. Recommended implementation for Sticky Keys is: Sticky Key feature invoked by tapping five times in a row on either shift key.

Once activated, touching any modifier key (shift, control, etc.) followed by another key will be presented to the system and application software exactly as if the modifier key and the other key were pressed concurrently. Immediately after the other key is pressed, the modifier key is automatically released.

Depressing a modifier key twice in a row causes that modifier to "lock down" until the modifier key is pressed a third time.

Any time any a modifier key and another key on the keyboard are depressed simultaneously, the feature immediately deactivates and the keyboard returns to normal operation. (Thus, the feature would automatically disappear if a normal typist began using a keyboard on which the feature had been active.)

The feature can also be turned off by hitting the shift key five times.

In systems that use a "shift click" feature (where the shift key is depressed while the mouse key is activated), the "Sticky Key" feature should work in conjunction with the mouse.

In systems with mice or other devices having multiple buttons that are sometimes held down simultaneously, alternate sequential activations should be provided.

If there are two modifier keys with the same function (e.g., two alternate keys) that can be distinguished as two separate keys by the operating system or software, then they should behave as if they are two separate Sticky Key keys (to allow the disabled user to activate programs which ask the user to depress two shift keys simultaneously to invoke special features or functions). If one of the keys is locked, however, hitting the other key should release the locked key (in case the user cannot remember which key they locked).

Whenever possible some indication (visual and/or auditory) of the key status should be provided) (Auditory indications should have visual alternative - see Item H1.)

Item P2: Timed Responses Adjustable or Defeatable

PROBLEM DEFINITION

Some individuals with poor coordination have slower or irregular reaction times, making time-dependent input unreliable.

Examples

The normal key repeat rate is too fast for some users, resulting in undesired characters. Programs that require a response within a short period of time or that utilize modes that shut off automatically or reset too quickly may also cause problems.

DESIGN RECOMMENDATION:

Systems requiring responses in less than 5 seconds, or a release of a key in less than 1.5 seconds, should include a provision for the user to adjust the time interval, or to have a non-time-dependent alternate method.

PRIORITY:

1. Individuals with slow response times need this ability in order to operate the equipment.

Current GSA Guideline

"Keyboard Repeat Rate. Currently the computer generates repetitions of a character if the key is held down. This is a problem for those users without sufficient motor control of their fingers to conform to the repeat tolerances of the keyboard. This feature would give the user control over the repeat rate. The user could extend the keyboard tolerances or turn off the repeat function completely."

NOTES

1. The key repeat rate adjustment option should include both the start delay and the repeat delay, as well as the ability to turn the repeat feature off.
2. Rates should be adjustable in five or more steps which vary the time interval in a nonlinear fashion.

Item P3: Alternate Method for Achieving Input Normally Done with a Pointing Device

PROBLEM DEFINITION

Some individuals do not have enough fine movement control to use some of the newer input methods, such as the mouse, touchscreen, etc.

Examples

Individuals with paralysis of the hands or motor coordination problems cannot accurately use a mouse, touchpad, joystick, trackball, or touchscreen.

Individuals who use a mouthstick, or those using specialkeyboard-simulating input systems, cannot operate a mouse or other analog pointing device.

DESIGN RECOMMENDATION:

Systems having mice or other pointing systems should have a method for carrying out all of the same functions from the keyboard.

PRIORITY: 1

Current GSA Guideline

"Input Redundancy. Currently numerous programs use a mouse as one of the input options. As the use of graphics increases so will dependence on the mouse as an input device. Some users with disabilities cannot use a mouse.

This feature would provide an emulation of the mouse using the keyboard and/or other suitable alternative input devices, e.g. joy stick, trackball, voice input, and touchpad. In effect, any movement control executed through the mouse could also be executed from alternative devices."

NOTES

1. This recommendation could be satisfied through a user-invokable operating system option which would use part of the keyboard to control the mouse cursor and mouse buttons, or to create simulated touchscreen and touchpad input, etc.
2. Systems that allow keystrokes as an alternate to mouse pointing help with, but do not fully solve this problem (e.g., rather than clicking on a cancel button, the individual can type a "C").
3. The use of cursor arrow keys to move through different options in dialog (set-up or adjust) boxes also assists with this problem.
4. Systems that are designed such that all mouse-activated functions can also be activated from the keyboard may satisfy this need.
5. Keyboard alternatives to mouse operations are frequently useful to the regular nondisabled user population as well.

Item P4: Media (Removable) Should Be Easily Inserted and Removed

PROBLEM DEFINITION

Some individuals with poor motor control or limited strength or manual dexterity (including those with no hand use) have difficulty grasping or handling materials delicately. Some individuals are unable to reach built-in media drives because of their position relative to the drive location.

Examples

Individuals with cerebral palsy often damage media surfaces or bend flexible floppy disks.

Individuals with limited reach or strength cannot reach built-in drives, especially on floor-mount computers.

Individuals with cerebral palsy, spinal cord injury, arthritis, etc., have difficulty reaching into floppy, CD ROM, and other media drives to remove media.

DESIGN RECOMMENDATION:

Removable media drives should allow media insertion and removal with minimal reach and manual dexterity.

PRIORITY: 2 - Increases efficiency of worker by removing the need to all for assistance each time removable media must be handled.

Current GSA Guideline: None

NOTES

1. This is most important in environments where diskettes, CD ROMs, and other removable media are exchanged regularly in the drive. It is less important when programs and data are accessed by modem or network, or from a local hard drive.

2. Removable media should be able to withstand fairly rough handling, and should preferably be "hard cased" to accept light clamping.
3. Removable media should eject and/or protrude a minimum of 3/4" to1 1/2" from the drive when unloading. This is true clearance beyond any frame and cover overlap. A clearance near or above the upper end of this range is preferred. Distances beyond 1 1/2" are desirable where possible.
4. Removable media drives which are available in external mount configurations allow special positioning of the drives for easier access.
5. Media/drives should be self-guiding, loading and unloading from the front by pushbutton or software ejection.
6. Pushbutton ejection systems, particularly those that can be operated with low pressure, help to address this problem.
7. Ejection buttons that are concave rather than flat are much easier to operate with a mouthstick or headstick.
8. Drives that involve a twisting motion are difficult to use.
9. Hard cases such as those on 3 1/2" disks are very helpful here.

Item P5: Controls and Latches Easily Accessible and Operable

PROBLEM DEFINITION

Some individuals who are weak, have poor or no use of their hands, or have limited reach have difficulty accessing and manipulating some conventional controls (or moving equipment in order to access controls).

Examples

Individuals with limited reach are unable to operate switches or controls located at the rear of the computer.

Individuals with limited dexterity (arthritis, cerebral palsy, etc.) are unable to use latches or controls that require twist motion.

Individuals with use of only one hand cannot open some laptop computers with dual latches which must be simultaneously released.

Individuals with low strength (MS, MD, and spinal cord injury) are unable to operate controls that require very much force (much more than 100 grams).For severely physically handicapped persons who are using alternate special keyboards (sip and puff keyboard, Morse code keyboard, eye gaze operate keyboard, etc.), only controls that can be operated from the keyboard would be accessible.

DESIGN RECOMMENDATION:

Controls (and latches) which are required on a regular basis for system operation should be accessible and operable with minimum dexterity.

PRIORITY: If only occasional adjustments are involved, then it is a Priority 3.If controls are needed for ongoing operation rather than occasional adjustments, then they would be Priority 1.

Current GSA Guideline None

NOTES

1. This becomes less critical if a control is for an adjustment that is only occasionally used.
2. The following are good features for controls (all light action)

a. Controls located at the front edge of the equipment Pushbutton controls (preferably concave) requiring less than 100 grams of pressure
b. Sliding or edge-operated controls
c. Up/down (integrating) control buttons
d. Double-acting pushbutton controls
e. Rocker switches (concave)
f. Controls that are operable from the keyboard are best (e.g., volume, display and printer controls, power - "sleep," etc.), since they also facilitate access to these controls by individuals who are using alternate or substitute keyboards (future systems)

3. The following should be avoided:
    a. Placement requiring the user to lean around the side or back of the equipment to see or operate the controls
    b. Controls requiring twist or push-and-twist in combination
4. A good rule of thumb is "IF YOU CAN PUT A STICK IN YOUR MOUTH AND REACH, OPERATE, AND ADJUST THE CONTROLS EASILY USING ONLY THAT STICK. . . YOU ARE IN GREAT SHAPE."

Item P6: Keyguard and/or Delay Before Acceptance of Keyboard Input

PROBLEM DEFINITION

Some individuals with limited movement control can inadvertently bump extra keys on their way to the desired key(s).

Examples

Individuals who have difficulty in eye/finger (eye/stick) coordination often strike unwanted keys before targeting the desired key. This includes individuals with tremor, incoordination, or those using headstick or mouthstick.

DESIGN RECOMMENDATION:

A special option (difficult to accidentally invoke) could be provided that would delay the acceptance of a keystroke for a preset, adjustable amount of time, and/or a keyguard or keyguard mounting provision could be provided.

PRIORITY: 4 - Individuals with this difficulty can use a third-party-supplied keyguard. Also, presence of this feature can be mistaken for a broken keyboard(see below).

Current GSA Guideline

"Keyboard Orientation Aids. . . . To assist a motor disabled user, a keyguard should be available to ensure that the correct keys are located and depressed.

A keyguard is a keyboard template with holes corresponding to the locations of the keys."

NOTES

1. The recommended software option would require any key to remain depressed for a continuous interval of time before it was recognized by the system. This option should be designed so that it must be purposefully loaded and activated each time, as a patch to the keyboard system from a special diskette. It is not recommended

that this be a standard system option, as it has the potential for causing the keyboard to appear to be broken (see below).

2. Once the feature is invoked, the keyboard will look "broken" to a normal user, especially if the delay is of any significant length. This is because when the normal, nondisabled user taps on the keys in the normal fashion, nothing happens (since the keys do not stay down long enough).

Even if the delay is set to a short period of time, the keyboard may still appear faulty. If a person is typing at normal speed, , few if any keys will be accepted, causing the keyboard to behave as if the keys are broken or erratic. If the individual hits the keys harder, however, the keys may appear to work (since pressing keys harder also causes them to be depressed longer).

It is therefore recommended that this feature not be included as a standard feature, but rather be treated as a specially loaded utility. Furthermore, it is recommended that when invoked, a large sign appear on the display, warning of the consequences as well as the "symptoms" of the feature when viewed by normal typists (especially in a shared user environment). This sign should remain on the screen until a confirming key is struck, to avoid missing the message if someone put the routine into an autoexec batch file.

Design Considerations for Individuals with Severe Physical Impairments (SP)

For individuals with more severe physical handicaps, modifications to the standard input devices are not sufficient to allow them to use the computer. For these individuals, some mechanism for connecting alternative keyboards, mice, and other input devices is required.

Item SP1: Alternate Input Connection Points -- External and Through System

PROBLEM DEFINITION

Some individuals with severe physical impairments must use special devices and programs (simulating keyboard, mouse, and touchpad input) in order to use the system.

Examples

Individuals who require an eyegaze or sip-and-puff controlled inputcannot connect their device in place of the normal input devices (keyboard, mouse, touchscreen, etc.)Scanning and other special input programs can be designed which would run in the background (or under multitasking) and replace the keyboard function. These systems, however, do not have a standard means to inject simulated keystrokes, touchscreen or mouse activity into the computer for use by the operating system and application programs. This inability on the part of the operating system to allow simulation of input device activity pr events the use of low-cost software solutions that provide alternate input systems for those who require them.

When computer systems are changed or upgraded, or when an individual changes jobs, their special input devices usually will not work on the new computer/model.

Architectural considerations that facilitate transport ability of such alternate input systems between operating systems and/or work station models is needed.

DESIGN RECOMMENDATION:

1. Systems should have an externally available connection point(s) (standard or special port{s}) for adaptive input devices; the connection should be an industry or company standard; and the computer should treat the input from the adaptive devices the same as input from other standard input devices such as keyboard, mouse, or tablet.
2. This ability to simulate input device activities should also be available to programs running in background on computers which support background processing or multitasking.

PRIORITY: 1 - Severely physically impaired persons are unable to access computers if no provision is made for connecting alternate input devices and programs.

CURRENT GSA GUIDELINE "Alternative Input Device. The capability to connect an alternative input device would be available to the user who is not able to use a modified, but standard keyboard. This feature would supplement the keyboard and any other standard input system used. The alternative input capability would consist of a physical port (serial, parallel, game, etc.) or connection capability so that an accommodation aid could augment the keyboard or replace it. The computer would regard this device as its keyboard and the user would be able to input any valid keystroke combination (e.g. CTRL + ALT + DEL) available from the regular keyboard. This alternative input capability would also support the mouse emulation described above." (previously discussed, in Item P3)

NOTES

1. One way that part (a) of this recommendation could be satisfied is by a system command which would cause input from a standard serial, parallel or other system port to be treated by the system and application programs exactly as if it had come from the computer's standard input devices (keyboard, mouse, etc.).
2. One way that part (b) could be satisfied would be for the operating system to have an "inject only" (write only) point or address to which simulated input could be sent. This injection point would have to be in front all system or program processing of the input, so that anything done through the standard input devices (including reset and switching between programs in a multitasking system) could be accomplished through this "injection point."
3. Blind individuals may not be able to access newer mouse or display- based computers without the ability to have their special display systems and/or programs simulate mouse or other types of display-based input.

Design Considerations for Individuals with Visual Impairments (V)

Visually impaired individuals have their primary difficulties with the output display, although newer display-based input systems (e.g., mice, touchscreens) which require eye hand co-ordination also pose problems. This group includes individuals who have failing vision and individuals with partial vision.

Item V1: Screen Image Enlargement Capability

PROBLEM DEFINITION

Some visually impaired individuals have difficulty seeing normal sized text and graphics images on the screen.

Examples

Individuals with low vision have difficulty reading the screen because the characters (text) and images are too small. Individuals with low vision have difficulty seeing the screen due to glare or distance.

DESIGN RECOMMENDATION:

Microcomputers should provide a means for

1. attaching larger (and repositionable) displays, and
2. for enlarging the image on the display.

PRIORITY: 1 - Some means for connecting larger displays is necessary.

A built-in zoom enlargement feature can reduce or eliminate the need for high cost or custom screen image enlargement equipment.

CURRENT GSA GUIDELINE

"Large Print Display. This feature increases the size of a portion of the screen for the low vision user. The process might use a window or similar mechanism that allows magnification to be controlled by the user. The user could invoke the large print display capability from the keyboard or control pad for use in conjunction with any work-related applications software.

If applications software includes graphics, then enlargement of graphics should also be available." (Current GSA - Initial Guidelines, October, 1987)

NOTES

1. A standard video connector or a slot that allows connection of a video controller card should satisfy part (a) of this recommendation.
2. Modification to the basic display support that would allow the user to "zoom" on any area of the screen would address part (b) of this recommendation.
3. Such a "zoom" feature would be most useful if the enlarged image could automatically track cursor movement during data entry, as well as pointing device (e.g., mouse) movement (real or simulated).
4. A zoom enlargement feature should be able to enlarge any area of the screen, and provide magnification up to 16 times original size, in at least 8 steps.
5. If the display contains both text and graphics, the zoom feature should work on any portion of the image.
6. If a very small cursor is used (e.g., an underline or a thin vertical line), it is helpful to have a means for substituting a larger cursor and/or causing the cursor to blink.
7. The above zoom capability might initially be provided by building "hooks" into the appropriate operating system functions that third-party manufacturers could use to write special zoom programs (although it would be useful to have some zoom capability built into the operating system itself).
8. If text-only screens are used, a useful option would be to allow the text to be reformatted into long, narrow columns (based upon the magnification selected) so that the user need only scroll in the vertical direction while reading text.

9. Advanced zoom features might include a split-screen option to allow two non-adjacent parts of the display to be viewed simultaneously (especially for database/spreadsheet programs).

Item V2: Display Colors Adjustable

PROBLEM DEFINITION

Some color blind end users have difficulty distinguishing some color pairs, such as green and red.

Examples

Color blind individuals cannot see text presented in some text- background color combinations.

Color blind individuals may not notice highlighted words when they are highlighted with a color and have no other distinguishing characteristic.

DESIGN RECOMMENDATION:

Where the color of graphics or text must be distinguished in order to understand information on the display, end users should be able to select the colors used.

PRIORITY: 1 - If color differentiation is required to operate the syst em, then individuals who cannot distinguish colors will not be able to operate the system.

Current GSA Guideline

"Color Presentation. Where colors must be distinguished in order to understand information on the display, color-blind end users should be able to select the colors displayed." (Current GSA - Initial Guidelines, October, 1987)

NOTES

1. If information is discernible in grey scales on a black and white screen, then a monochrome display mode would satisfy the recommendation.
2. If the colors chosen are of sufficiently different intensity (light yellow versus dark red) that they would be distinguishable as different shades even to a color blind individual, this recommendation would be satisfied. Similarly, if the colors and intensities were chosen such that they were distinguishable by individuals with all types of color blindness, the recommendation would be satisfied.
3. Choice of colors for all key labels and other documentation should take into account the limitations of color blind individuals.

Item V3: Easily Readable Letters on Keys and Important Controls

PROBLEM DEFINITION

Some visually impaired individuals have difficulty identifying keys and operating controls with existing (small) lettering.

Examples

Individuals with low vision have difficult reading keys with small labels. They also have difficulty reading controls which use small lettering or low contrast colors.

DESIGN RECOMMENDATION:

Lettering on keys and controls required for operation should be easily readable.

PRIORITY: 2 - Large, easily readable lettering facilitates the initial learning of equipment, and facilitates the efficiency of operating occasionally used equipment.

Current GSA Guideline

None

NOTES

1. Large lettering and the use of high contrast colors facilitates readability. Light gray on slightly darker gray, and other similar stylish but low contrast combinations should be avoided.
2. Lettering which utilizes most of the key top surface facilitates readability.
3. All keys could be made recappable. This would allow the use of special keytop kits for visually impaired persons that could incorporate extra large, high contrast letters, colors, and/or symbols to facilitate key identification. These could be either custom key caps or key caps with removable clear plastic lids into which special legends could be placed. This would be particularly applicable for dedicated workstations.
4. Sticky tape with unique symbols to identify the various keys, either on or near the key, could be employed, but is less desirable unless permanent.
5. Larger, easily readable lettering improves the learning process and efficiency of occasionally-used equipment for nonimpaired users as well.

Design Considerations for Individuals Who Are Blind (B)

Blind individuals have their primary difficulties with the output display, although newer display-based input systems (e.g., mice, touchscreens) may also pose problems. The primary solution strategies involve providing a mechanism to connect alternate display or display translator devices to the computer, and providing alternatives to display-based input.

Item B1: Display Data Available at External Connection Point D- and through System

PROBLEM DEFINITION

Blind individuals (and those with severe visual impairments) must use special alternate displays (voice, Braille, tactile, etc.) to view the information normally displayed visually. In order for them to use these alternate displays, it is necessary that these special displays have access to the contents of the computer's normal display screen. When the blind individual owns or controls the computer (and can modify it, insert cards, etc.), access to the screen's contents can be provided via the internal bus or memory access. For computers that are shared or public, access must be via an externally available connection, since the user often is not able to open or physically modify the computer.

DESIGN RECOMMENDATION:

1. Visually displayed information should be available at an external connection point (standard or special port), preferably in an industry or company standard format. This information should be provided in one of the following formats (listed in order of preference): a description of the information on the display, a character listing (for character-based screen displays), or a bit image.
2. If an operating system supports multi-tasking, this display information should also be available to adaptive programs running in the computer.

PRIORITY: 1 - Access to display data is required by blind individuals in order to access and use the computer.

Current GSA Guideline

"Access to Screen Memory for Text. The capability to access screen memory is necessary to support the speech and/or tactile braille output requirement of many blind users. Currently, blind users are able to select and review the spoken or braille equivalent of text from any portion of the screen while using standard application software. The access to the contents of the screen must continue to provide third party vendors the ability to direct it to an internal speech chip, a speech synthesizer on a serial or parallel port, or a braille display device.

Access to Screen Memory for Graphics. Information that is presented graphically also needs to be accessed from screen memory in such a manner that as software sophistication improves, it may eventually be interpreted into spoken output." (Current GSA - Initial Guidelines, October, 1987)

NOTES

1. This is the most important and highest need area for blind individuals' accessing newer "graphics-oriented" computers. Without this capability, they cannot use the computer.
2. A bit image dump would minimally satisfy this item, but it would be much more difficult for an adaptive aid (access system) to interpret than a properly designed display description format. (See Note 7)
3. The existing "video output" on most computers does provide the display image in a continuous fashion on an external connector. This should (barely) fulfill recommendation (a) until more suitable solutions can be implemented.
4. Documenting procedures to access the display memory or providing a system call that would provide a copy of the display memory would satisfy recommendation (b). Again, access to a description of the screen is far superior to a bit image.
5. The system might provide a description of the screen contents on command, or a mode might be invoked where all information that is sent to the display processor (software or hardware) is also sent to an external port (or adaptive software running in the background).
6. The external connector could be a standard parallel, serial (quite slow), or other I/O port.
7. At the present time (early 1988), an appropriate screen description format does not exist, nor do special adaptive aids capable of handling this type of input (although several are now being explored in research).
8. Standardization of software-based screen drawing routines would allow third-party software to intercept these calls and obtain the information before it got to the screen.
9. The goal should be to allow information to be intercepted before it gets to the image creation phase, so that it can be more easily translated into a form usable by the visually impaired and blind users.

Item B2: Alternative to Eye-Hand Coordination Input Devices Where Possible

PROBLEM DEFINITION

Blind individuals cannot use an input device (such as a mouse, trackball or touchscreen) which requires constant eye-hand coordination and visual feedback.

Examples

Blind individuals cannot use a mouse or trackball, because they cannot monitor the mouse cursor's continually changing position in relation to the image on the screen.

Blind individuals have difficulty in precisely locating areas spatially on touchscreens.

DESIGN RECOMMENDATION:

If a computer has a standard input system that requires continual visual feedback to operate (e.g., mouse, touchscreen), the computer would preferably have an alternative means or mode for achieving as many of the functions as possible. This alternative means or mode should be available at any time, and should not require continual visual feedback.

PRIORITY: 1 - Needed for blind individuals to be able to operate systems and software which incorporates a mouse or similar pointing device.

Current GSA Guideline

None

NOTES

1. Functions and commands (e.g., menu selections and dialog box responses) that are also achievable from the keyboard as keystrokes would satisfy this requirement. This would be the fastest access technique for blind individuals, and would also facilitate use by persons with physical disabilities.
2. It is recognized that some activities, such as free-hand sketching, cannot be easily done other than with a mouse or other pointing device requiring eye-hand coordination.
3. It is probably impossible to solve this problem entirely (see Note 2). It is a problem, however, that can be largely eliminated through maximizing the options for computer operation from the keyboard (including keyboard equivalents for pointing functions).
4. The existence of macro programs that allow keyboard commands to initiate pre-stored mouse and keyboard actions can partially but not completely address this problem.

Item B3: Nonvisual Indication of Toggle Keys' State

PROBLEM DEFINITION

Blind individuals cannot determine the state of keyboard (and other) toggle switches which provide only visual feedback as to their status.

Examples

Blind individuals do not normally press toggle keys without knowing it, but when they do, they need a mechanism for determining status of any toggle key that does not physically lock down (Num Lock, Caps Lock, Scroll Lock, Insert, Delete, etc.).

Not all software provides toggle key status on the screen (including MS-DOS and some applications). (Software that does provide toggle key status on the screen can be interrogated by the blind individual's screen reading software.)

Some applications that present toggle key status on the screen incorrectly report the actual state of the toggle keys as represented by keyboard indicators.

DESIGN RECOMMENDATION:

A non-visual indication of the toggle keys' state should be provided or available on request.

PRIORITY: 3 - Blind individuals normally don't hit toggle keys without knowing it, but when they do, they need some mechanism for determining the status.

Current GSA Guideline

"Toggle Keystroke Control. Currently toggle keys are employed which require visual feedback to know if a key is on or off. This feature would provide an alternate mode that does not require visual feedback to know the status of any toggle key."

NOTES

1. If status is presented on the microcomputer's standard display, it is considered accessible, since the screen contents must already be accessible to the blind user.
2. A system that would provide distinct lock and unlock tones when toggle keys are activated would satisfy this requirement, even if the same pair of tones was used for all toggle keys.
3. A command from the keyboard that would cause the system to check the status of each of the toggle keys and present a unique audible signal to indicate the status of each key would also meet this need.
4. Some programs on MS-DOS machines get out of sync with the system toggle status (and keyboard indicators), creating problems. These software packages, however, usually have an on-screen display of toggle key status that can be viewed by the blind user.
5. There is some question as to the need for this feature to be provided within the standard system software or hardware. For a blind person to use the computer, he/she would need some type of screen interpretation device (Braille, speech, etc.). Such systems already have built into them methods for determining the status of toggle key switches. As totally external alternate display systems are developed, however, this feature will need to be incorporated into the standard system unless the toggle key information would somehow be made available externally to the adaptive system.
6. If all toggle key have bright visual indicators on them, then a small battery operated light probe can be used by the blind individual to check the status of the keys.
7. Design rules for software developers should include a statement requesting that they use (and/or update) the system status flags so that they agree with the program's use of them. 8) The use of toggle keys that can be directly sensed by blind users would eliminate this problem. Examples include rocker switches or double-acting (pop-up, lock-down) keys.

Item B4: Nonvisual Key Labelling

PROBLEM DEFINITION

Blind individuals have difficulty in identifying some of the keys on keyboards and keypads, as well as locating "home" keys on keyboards and keypads.

Examples

DESIGN RECOMMENDATION:

Keyboards/keypads should have tactilely discernible key edges (e.g., no flat membrane keyboards without ridges).

A distinct tactile marking should be provided on the home keys for keyboards and keypads.

Optional or built-in nonvisual key labelling should be provided or available.

PRIORITY: 3 - Most important when an individual is learning a keyboard or trying to locate a seldom-used key.

Current GSA Guideline

"Keyboard Orientation Aids. There are several different keyboards available for current personal computers. To orient a visually impaired user to a particular keyboard, a set of tactile overlays should be available to identify the most important keys (e.g. ESC, ENTER, CTRL, ALT, and several key letters and numbers). The tactile overlays might be keycap replacements or transparent sticky tape with unique symbols to identify the various keys.

NOTES

1. Placing control keys near tactile landmarks, such as along the edges of the keyboard (not burying them in the center) allows tactile markers to be placed very discretely and stylishly alongside controls. Symbols may be embossed in the case in the same color, next to the control key, so that the user can touch and identify it.
2. Use of spatial grouping of keys (such as the cursor keys arranged in a T) provides natural tactile landmarks. Using small groups of keys that are separated from the other keys also facilitates key finding (e.g., second key in the second group).
3. Maintaining a "standard keyboard" layout is very helpful, and allows blind individuals to switch between computers or systems without confusion.
4. Overlays can be used that put tactile labels alongside the keys located around the edges of the keyboard. A separate tactile (including Braille) map of the keyboard could also be used.
5. A common approach for providing tactile markings of the home keys is to put nibs centered on or at the front edge of the F and J or D and K keys on the keyboard, and on the 5 key on a keypad.
6. Flat membrane keypads or buttons should use ridges around keys, a bump (or depression) in the center of the keys, or a plastic guard (with holes for each key) to make the keys tactilely locatable. This is very important even if the keys are only labeled visually -- especially for control buttons on peripheral devices (like a printer) where the function of the keys can be easily memorized if they can be tactilely located on the control panel.
7. If the computer has voice output capability, a command could temporarily disable the keyboard but cause keys to be spoken when they are pressed, to allow an individual to locate a particular key auditorially.

Design Considerations for Individuals Who Are Hearing Impaired or Deaf (H)

Hearing impaired and deaf individuals currently have little difficulty in using computers. Visual redundancy of clicks and tones and other auditory output would address most of the problems in this area. The primary concern is ensuring that future voice output information is provided in a redundant form that hearing impaired or deaf individuals can also understand.

Item H1: All Audible Output Also Provided in Visual Form

PROBLEM DEFINITION

Individuals who are deaf cannot receive any information (tones, voice, etc.) presented in audible form.

Examples

Individuals who are deaf cannot hear beeps or other tones that are intended to alert them to problems or system status.

Individuals who are deaf cannot hear spoken output from a computer.

Individuals who are deaf cannot hear the disk drives and cannot tell when they are in operation if no visual indicators are provided.

DESIGN RECOMMENDATION:

All information presented in auditory form which is required for system operation and error detection should also be provided or available redundantly in an appropriate visual form.

PRIORITY: 1 - Where the auditory information is required for system operation, deaf individuals would be unable to operate the device if the information is not also provided in visual form.

Current GSA Guideline

"Information Redundancy. Currently, several programs use the speaker to beep warnings or errors to the user. Some programs do not have the capability to present the warning visually to the hearing impaired user. This feature would allow the user to have information redundancy by presenting a visual equivalent of the beep on the monitor. This might be accomplished by either a manual screen indicator (i.e., the user would have to indicate that he has seen the warning indicator by entering a key sequence to remove the indicator from the screen) or an automatic screen indicator (i.e., the warning would be presented for a period of time and then removed automatically).

NOTES

1. Warning beeps and tones could be accompanied by a visual indicator, or flicker on the screen.
2. Synthesized or digitized speech messages could be redundantly presented in visual form.
3. Provide as a part of the operating system a "feedback preference" setting or "hearing impaired user" flag that would be set by any user who wanted visual support to accompany auditory output. The operating system and application programs could then provide full visual redundancy for all audio output when the flag is set. Suggested settings for a "Feedback Preference" setting might be:
    a. Sound is okay.
    b. Use visual cues.
    c. Use locking visual cues.
        i. This last setting would be used by individuals who do not look at the screen while typing, and who might otherwise miss cues that are only displayed for a moment.
        ii. Application programs could check for the feedback preference setting and provide visual cues to accompany auditory cues when they are so requested. Programs with speech output could provide what amounts to a caption on the screen, to accompany or replace the speech output when the preference flag is set.

iii. In addition to being useful to people who are deaf, this feedback preference capability would be useful in noisy environments, where beeps might be missed, and in quiet environments such as libraries where the sound level may be set very low or off, to avoid disturbing others.

4. Training materials (videotapes, audiovisual computer presentations, etc.) would not normally be considered as "required for operation" and would be exempt (although subtitling would be preferred).
5. In the future, education, training and other software may include speech to accompany on-screen activity. This may be more text than would normally be displayed on screen. Operating systems could support a sort of built-in closed captioning capability that could then be used by application programs. A deaf individual could enable the captioning feature by setting the "feedback preference" or a "hearing impaired user" flag. The closed captioning feature would then display text on the screen (sent by the application program) to accompany the spoken text.
    a. This feature would also facilitate use of equipment by individuals for whom English is a second language, individuals who have poor language skills, or in a noisy environment.
6. The presence of a headphone jack provides the opportunity to plug in a small LED that would provide a visual flicker whenever sound was emitted from the speaker. This would be sufficient to indicate that a beep had occurred, but insufficient to distinguish the type of beep or speech. A microphone placed next to the speaker might provide a substitute for a headphone jack, except that it is likely to pick up loud noises in the environment (e.g., setting down a book hard), which might give false flashes.
7. A small LED might be wired in parallel with the speaker to provide visual feedback of auditory activity.
8. If different tones are used to convey different messages, they should be accompanied by different visual signals.

Item H2: Audio Output Should be Adjustable as well as being Available in a clear form for Amplification

PROBLEM DEFINITION

Individuals with hearing impairments have difficulty hearing auditory output from computers, or cannot turn up volume sufficiently due to environmental constraints.

Examples

Individuals who are hard of hearing (not deaf) have difficulty hearing beeps that indicate errors when typing or issuing commands.

Individuals who have hearing impairments are unable to turn the volume up sufficiently in some environments, such as libraries (not allowed) or a noisy environment (not enough volume).

DESIGN RECOMMENDATION:

1. Sound volume should be adjustable and/or reasonably loud.
2. It should also be easily available in a clear form for amplification

PRIORITY: 1 - (If all auditory information is provided in a redundant visual form [see H1], the importance of Item H2 is much less.)

Current GSA Guideline

"Auditory Output Capability. . . . The volume should be adjustable by the user and a headset jack should be available."

NOTES

1. An adjustable and fairly loud volume is particularly helpful to aging individuals and others with mild hearing impairments who do not normally carry or use hearing aids or other sound amplification devices. Volume that is "reasonable" for a particular computer is a function of the unit's size, usual operating environment (quiet/noisy) and type of sound. Beeping tones that have a strong component below 750 hertz are easier for many hearing impaired persons to hear.
2. Placement of the sound source near a quiet (no loud fan nearby) and user-accessible location on the equipment (such as an edge), or the provision of an audio jack, would satisfy part (b) of this recommendation. Hearing impaired individuals could then carry a pair of headphones or headphones plus a small, $25 battery-operated microphone and amplifier to provide the necessary sound levels. This allows the user to select an amplifier that matches the particular volume level they need. (The jack or portable microphone could also drive an inductive neckring, which would allow the sound to be directly coupled to the user's hearing aid.)
3. The headphone jack provides the greatest privacy, which is important for "quiet" environments (such as a library) when (if) text-to-speech synthesis becomes native in the workstation, or when applications utilize speech output as a standard user interface (especially in a multiple workstation environment, where it may be difficult to determine which computer the speech is coming from).

Design Considerations For Individuals Who Have Seizure Disorders (S)

Item S1: Displays and Software Avoid Some Refresh and Update Frequencies

PROBLEM DEFINITION

Individuals with seizure sensitivities may be affected by cursor or display update frequencies, increasing the chance of a seizure while working on or near a display screen.

DESIGN RECOMMENDATION:

Displays should avoid whenever possible refresh or update flicker or flashing frequencies which are most likely to trigger seizure activity.

PRIORITY: 1 - Important to health and physical safety of individuals with seizure sensitivities.

Current GSA Guideline

"Cursor Presentation. Where cursors or other indicators on the screen blink, the end user should be able to adjust the blink rate. This feature accommodates persons with seizure disorders who may be sensitive to certain frequencies of flashing light."

NOTES

1. This is an area of potential concern which has only been partially defined and quantified.
2. Somewhere between 1 in 25,000 and 1 in 10,000 are affected by photosensitive epilepsy (total: 25,000-100,000 people) (Cakir, Hart, & Stewart, 1980, Visual Display Terminals, pp. 219-220, John Wiley & Sons).

3. The flash rates most likely to induce convulsions in photosensitive epilepsy have been found to be between 10 and 25 hertz, with a peak around 15-20 hertz.
4. This chart illustrates the relative sensitivity of individuals to different frequencies: it shows the relative sensitivity of photosensitive patients in whom a photoconvulsive response was elicited by 2 second trains of flashes, expressed as a function of the flash frequency. Solid dots = response with eyes open; open dots = eyes closed (Jeavons, P.M., and Harding, G.F.A. [1975] Photosensitive epilepsy. London: Heinemann.)
5. Sensitivity to frequencies below 8 hertz is uncommon, so that in connection with VDTs, a 5 hertz or lower blinking cursor is unlikely to prove epileptogenic (Sakir, Hart, & Stewart).
6. There is a good deal of evidence to suggest that combined presence of pattern and flicker may extend the sensitivity range. The results from one investigation, for example, showed that while the mean sensitivity range for diffuse stimulation was 11-13 hertz, the range was increased to 10-43 hertz with patterned stimulation. This difference confirms a conclusion that has been drawn by most researchers in the field, that pattern stimulation is more epileptogenic than diffuse stimulation. It has also been found that many photosensitive epileptics are not only sensitive to flicker but also to stationary striped patterns, and that by vibrating patterns the incidence of pattern sensitivity is doubled (Sakir, Hart, & Stewart).
7. Stimulation in the 30 hertz range may occur in some fast phosphor interlaced displays. Stimulation in the 10-20 hertz range can occur with systems that blank and redraw the screen rapidly, such as when scrolling through a display or flashing very quickly across a series of images. This can also happen when a computer program executes a keyboard macro within an application program. The flash rate is not necessarily uniform, but can be quite rapid on a fast computer. Poorly executed animation that produces a flickering image in this range might also cause a problem.
8. A seizure-sensitive individual need not necessarily be working directly at a piece of equipment in order to be affected by the device, although they would need to be in visual contact with it.

Design Considerations that Would Facilitate Development of Computer Access Devices by Third-Party Manufacturers (M)

Item M1: Manuals Available in Electronic Form

PROBLEM DEFINITION

Blind individuals cannot read printed text, and physically impaired individuals cannot handle printed documentation.

DESIGN RECOMMENDATION:

Make manuals and other important documentation available in electronic form.

PRIORITY: 2 - Facilitates learning of systems and occasional reference. Sometimes needed for daily operation.

RECOMMENDED EXCEPTIONS: Software manuals and manuals sold separately from physical equipment might be excepted (due to software piracy problems).

Current GSA Guideline

"Documentation. The vendor will maintain a copy of all current user documentation on a computer, and will be responsive in supplying copies of this documentation in an ASCII format suitable for computer-based auditory review or brailling."

NOTES

1. Availability of manuals from third-parties (Library of Congress, American Printing House for the Blind, etc.) should fulfill this requirement.
2. For documentation to be completely accessible, all information presented graphically should also be presented in text.
3. When full manuals are not available (and even when they are), command or reference summaries in electronic form or on-line are very helpful.
4. It is recognized that there is a problem in providing electronic copies of software manuals and manuals that are not provided along with a piece of hardware, since provision of electronic versions of software manuals facilitates software piracy. Manuals that are normally included directly with the hardware, however, could be made available in electronic form with little or no risk to the manufacturer.

Item M2: Speech Output Compatible

PROBLEM DEFINITION

Individuals who are severely visually impaired or blind often use screen access programs which read the contents of the screen back to the individual, using a speech synthesizer. These special access programs need some way to access speech synthesis capability.

Speech impaired individuals and deaf individuals who are also speech impaired could also use computers which have speech output capability for communication (either in person or over the telephone).

DESIGN RECOMMENDATION:

A speech output capability would preferably be built in or available via connection of a speech synthesizer to an output port.

PRIORITY: 2-4 - The ability to at least connect a voice synthesizer is a high priority. Having the speech synthesis built into the computer is very useful, but a lower priority, as long as an external synthesizer can be connected.

Current GSA Guideline

"Auditory Output Capability. The auditory output capability on current personal computers is sufficient to beep and play music. Some users with disabilities, however, may require speech capability. For speech to be generated on today's computers, a speech synthesizer is required. The capability to support a speech synthesizer must continue to be available in future generations of computers or this capability must be internalized through an upgrade of the computer's internal speaker. Regardless of the methodology chosen, the volume should be adjustable by the user and a headset jack should also be available."

NOTES

1. The availability of an (unused) standard RS232 serial port on a computer is sufficient to guarantee that a synthesizer is available that can be used with the computer.
2. The ability of a computer to generate its own synthesized speech is a function of the quality of the speaker, the audio amplifier, and the sound generation system. Although it is possible to generate speech output from a speaker connected to a

bus data line, high quality speech generally requires a sound synthesizer chip, preferably one capable of generating sine wave output.

3. A standard add-in board that could add voice would be useful. Built-in voice would be better, especially in portable computers which have only one serial port.

Item M3: Special Display Window Which Can Stay Visible (on top)

PROBLEM DEFINITION

Some operating systems do not provide a mechanism that allows programs running in the background (or under multi-tasking) to provide visual information continuously to the user. This prevents the use of low-cost software-based input systems, which require continuous visual selection or feedback.

Examples

Special adaptive access (input) programs put a keyboard image on the screen, and the user "types" by using a cursor controlled by head movements, eye gaze single switch scanning, etc. This window must be able to always remain "on top." If this window "keyboard" simulated both the keyboard and mouse movements for the user, and the window were to disappear (behind another window), the user would have no means to bring it forward, and would be locked out (since they would no longer have access to their "keyboard" or "mouse").

DESIGN RECOMMENDATION:

Windowing environments would preferably have the ability to open and maintain special windows which can remain always fully visible (for use by special input routines).

PRIORITY: 4 - This feature can greatly reduce the cost of providing access to a computer by allowing use of special adaptive software in place of a separate alternate access system.

Current GSA Guideline

None

NOTES

1. The special window should cover only part of the screen, and be movable and shrinkable, to allow the user to move it around to view different parts of the screen as required.
2. This feature can greatly reduce the cost of providing access to a computer by allowing the use of special adaptive software running in the computer instead of a separate hardware alternate access system.

Item M4: Connection Point for Switches or Transducers "

PROBLEM DEFINITION

Many computers have no provision for connecting external switches needed for some adaptive access programs.

Examples

An eyeblink-operated scanning program needs a way to connect the eyeblink switch to the computer. A sip-and-puff Morse code input program needs a way to connect two switches.

DESIGN RECOMMENDATION:

Systems would preferably provide a standard way of connecting at least two momentary contact (SPST) input switches.

PRIORITY: 4 - This feature lowers the cost of adapting workstation computers by allowing easy connection of switches and use of internal access software.

Current GSA Guideline

None

NOTES

1. Connection point for switches could be implemented as dedicated pins on an already existing connector, or optional use of seldom used signal lines already existing on a connector.
2. The ability to connect analog transducers as well as binary switches is desirable, since it increases the input options for special software.
3. Arrays of up to 128 switches (8 x 16) are currently used as special inputs for adaptive software.

Item M5: Method for Distinguishing Macro Input from Keyboard Input"

PROBLEM DEFINITION

Some software programs discard certain keystrokes that show up in typing buffers, interfering with the user of special "macro"-based acceleration programs.

EXAMPLE:

This problem usually arises when application software throws away strings of multiple backspace and other cursor movement characters. This is done in programs like Microsoft Word to avoid the overshoot problems such as are encountered in Lotus 1-2-3 when the back arrow key is held down until the desired position is reached (or until the desired deletions are completed). This tendency to throw away multiple back arrow or back space keystrokes when they rapidly appear, interferes with macros used by disabled individuals as well as some input acceleration programs such as abbreviation expansion (which must erase the abbreviation before printing the expansion).

DESIGN RECOMMENDATION:

Operating systems would preferably provide a means for distinguishing between typed, auto-repeat, and macro-generated "keystrokes" so that they can be treated differently by the operating systems and application software.

PRIORITY: 4 - The presence of this feature allows the use of special software which increases the input efficiency of physically disabled individuals, but is not required for their access to computers.

Current GSA Guideline

None

NOTES

Item M6: Keyguard or Keyguard Mounting Provision

PROBLEM DEFINITION

Individuals with poor use of hands, or using mouthstick, headstick, etc., may require the use of a keyguard (a plate with holes over each key) in order to accurately use a standard keyboard. Third-party manufacturers make keyguards, but have difficulty mounting them to keyboards.

DESIGN RECOMMENDATION:

Provision would preferably be made in the design of the keyboard to facilitate keyguard mounting. In addition, the keyguard could be made available directly from the manufacturer.

PRIORITY: 5 - Would increase the ease and lower the cost for third-party manufacturers to develop keyguards for computers.

Current GSA Guideline

"Keyboard Orientation Aids. . . . To assist a motor disabled user, a keyguard should be available to ensure that the correct keys are located and depressed."

NOTES

1. The largest problem is with shared computers, where the keyguard must be removed and replaced. Velcro or posi-lock fasteners are currently being used in these applications.
2. Keyguard mounting might be accomplished by incorporating a groove in the side of the keyboard, with perhaps a dimple in the groove where it would not show. The keyguards could then slide into place.
3. Sculptured keyboards complicate the fabrication of keyguards.
4. With portable computers, it would be useful to have sufficient clearance above the keyboard so that a keyguard could remain in place when the computer was closed.