

Computer and Information Technology Assisted applications

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ABSTRACT

This paper introduces the how the computer and information technology is used to help individuals with disabilities.

Engineers at the Georgia Institute of Technology say that a new technology called Tongue Drive system will be helpful to individuals with serious disabilities, such as those with severe spinal cord injuries and will allow them to lead more active and independent lives.

Assistive technology is technology used by individuals with disabilities in order to perform functions that might otherwise be difficult or impossible. Assistive technology can include mobility devices such as walkers and wheelchairs, as well as hardware, software, and peripherals that assist people with disabilities in accessing computers or other information technologies. For example, people with limited hand function may use a keyboard with large keys or a special mouse to operate a computer, people who are blind may use software that reads text on the screen in a computer-generated voice, people with low vision may use software that enlarges screen content, people who are deaf may use a TTY (text telephone), or people with speech impairments may use a device that speaks out loud as they enter text via a keyboard.

INTRODUCTION

Assistive Technology

Technology has removed many barriers to education and employment for visually impaired individuals. Students with visual impairments can complete homework, do research, take tests, and read books along with their sighted classmates, thanks to advances in technology. Adults with visual impairments can continue to work and pursue a tremendous range of careers because of the use of computers and other devices.

These include:

Assistive technology programs that run on off-the-shelf computers can speak the text on the screen or magnify the text in a word processor, web browser, e-mail program or other application Stand-alone products designed specifically for people who are blind or visually impaired, including personal digital assistants (PDAs) and electronic book players provide portable access to books, phone numbers, appointment calendars, and more.

Optical character recognition systems scan printed material and speak the text. Braille embossers turn text files into hard-copy braille.

This section provides a wealth of information and advice for acquiring and using assistive technology effectively.

Video Magnifiers

A video magnifier, or closed-circuit television (CCTV) system uses a stand-mounted or handheld video camera to project a magnified image onto a video monitor, a television (TV) screen, or a computer monitor. There is considerable versatility in types of video magnifiers available today.

Cameras with zoom lenses provide variable magnification. In most of these systems, magnification level and focus are set after choosing a comfortable and functional working distance between the camera and the material to be viewed. Some systems use an auto-focus camera. Lower cost CCTVs often use cameras that have a fixed focus and cannot vary magnification or camera-to-target distance. Most cameras also need their own light source.

Cameras that are mounted on a fixed stand require the reading material to be placed under the camera and moved across and down the page. To make the process of viewing easier, a table

that is movable from the top of the page to the bottom and side to side (referred to as an xy table) is used with most stand-mounted cameras. Stand-mounted cameras are particularly effective for handwriting because a hand can fit under the camera.

In contrast to stand-mounted cameras, handheld cameras are portable systems designed for bringing the camera to the material to be viewed. They can magnify almost anything within reach, including labels on packages of food and medicine. Handheld cameras are often on rollers, which make them easier to move across a flat working surface. Some manufacturers of video magnifiers that use handheld cameras offer a writing stand as an accessory.

All video magnifiers offer the option of viewing black letters on a white background or white letters on a black background. Controls for contrast and brightness are also standard. Many video magnifiers also provide other special on-screen features and controls including underlining or overlining of text. Some systems work jointly with a computer, offering the option of sharing the computer monitor. Color video magnifiers are useful for reading materials in which color is crucial, such as maps and color photographs. A radical departure in design from conventional video magnifiers is the use of head-mounted displays (HMD). They offer portability and new ways of viewing the display. The ability to capture and save an image is also a new function that has recently become available.

Typically, video magnifiers that use a camera mounted on a fixed stand and xy table are in the \$1,800 to \$4,000 price range. Lower cost video magnifiers that plug into a TV are in the \$400 to \$1,000 price range.

Eye fatigue and other physical problems can result if the user does not have sufficient vision to read for a significant period of time without tiring. It is advisable for people considering purchasing a CCTV to have a low vision evaluation and consult with a low vision specialist who can help with determining which product is appropriate.

Braille Technology

Blind or visually impaired people who read braille can use the following specialized equipment:

Braille display technology which provides access to the information on a computer screen in braille.

Braille printers that provide hardcopy information from computer devices.

Electronic braille notetakers that provide a powerful alternative to mechanical notetakers such as the Perkins Brailler or slate and stylus.

Braille Displays

These devices operate by raising and lowering different combinations of pins electronically to produce in braille what appears on a portion of the computer screen. They show up to 80 characters from the screen and are refreshable, that is, they change continuously as the user moves around on the screen. The braille display sits on the user's desk, often underneath the computer keyboard. The advantage of the braille display in comparison to synthetic speech is in its direct access to information, the ability to check format, spacing and spelling, and the fact that it is quiet. The cost of braille displays is in the \$3,500 to \$15,000 price range, depending on number of characters displayed.

Browse Braille Display Products

Braille Printers

After being sent information to be brailled from computer devices, braille printers do the actual embossing of braille onto paper. They are the braille counterpart to ink printers but they differ in that they use solenoids to control embossing pins, they typically print on heavy weight paper and require more pages than print, and they are much slower and noisier. Interpoint printers emboss braille on both sides of the page. The price of a braille printer is directly related to the volume of braille production required—between \$1,800 and \$5,000 for smaller volume production and between \$10,000 and \$80,000 for larger volume production.

The first step in converting a computer file into a braille document is to choose the type of braille. Computer braille is a one-to-one representation of what appears on the screen, grade 1 braille consists of letters, numbers and punctuation marks, and grade 2 braille includes contractions of common combinations of letters and words. To print grade 2 braille requires the use of a braille translation program which takes the computer text file, inserts the proper contractions, and formats the document properly for the braille page. The cost of braille translation programs is between \$200 and \$500, depending on the sophistication of the program.

Optical Character Recognition Systems

Optical character recognition (OCR) technology offers blind and visually impaired persons the capacity to scan printed text and then speak it back in synthetic speech or save it to a computer. Little technology exists to interpret graphics such as line art, photographs, and graphs into a medium easily accessible to blind and visually impaired persons. It also is not yet possible to convert handwriting, whether script or block printing, into an accessible medium.

There are three essential elements to OCR technology—scanning, recognition, and reading text. Initially, a printed document is scanned by a camera. OCR software then converts the images into recognized characters and words. The synthesizer in the OCR system then speaks the recognized text. Finally, the information is stored in an electronic form, either in a personal computer (PC) or the memory of the OCR system itself.

The recognition process takes account of the logical structure of the language. An OCR system will deduce that the word "tke" at the beginning of a sentence is a mistake and should be read as the word "the." OCR's also use a lexicon and apply spell checking techniques similar to those found in many word processors.

All OCR systems create temporary files containing the texts' characters and page layout. In some OCR's these temporary files can be converted into formats retrievable by commonly used computer software such as word processors and spreadsheet and database software. The blind or visually impaired user can access the scanned text by using adaptive technology devices that magnify the computer screen or provide speech or braille output.

Current generation OCR systems provide very good accuracy and formatting capabilities at prices that are up to ten times lower than a few years ago. If you have a PC, the price range for a PC-based OCR system is \$1,300-\$2,000. Self-contained OCR systems and those that come bundled with a PC are in the \$4,800-\$5,500 range.

Now that it is possible to choose from among several different OCR systems, other considerations have become as important as price.

Does the OCR system:

- require installation into a PC or is it a self-contained unit?
- recognize a wide variety of typewritten and typeset documents including books, magazines, mail order catalogs, newspapers, and bank statements?
- maintain the layout of the original text?
- recognize columns of text with a minimum of user intervention?
- require a minimum of computer knowledge to operate?
- come with documentation that is easy to understand and in an accessible medium?
- provide "online help" that can be accessed while using the system?
- come with ongoing technical support from the manufacturer?
- support different types of scanners, that is, flat-bed, sheet-fed, hand-held, and so on?
- scan material at an efficient speed?
- handle various sizes of paper and horizontally formatted documents?

Defining Assistive Technology

The term assistive technology usually brings to mind high-tech devices, but federal legislation defines assistive technology as "any item, piece of equipment, or product system . . . that is used to increase, maintain, or improve functional capacities of individuals with disabilities." A low-tech device such as a pencil with tape wrapped around it to make it easier to hold for a student who has impaired muscle control in her hands is included in the federal definition of assistive technology, as is a robotic device that manipulates equipment in a science laboratory for a blind chemistry student. The range of devices available for people with disabilities is so broad that discussing all the various types would be impractical here. Adaptive devices have been designed for persons with virtually all identified disabilities, although fewer devices are available for cognitive impairments than for the areas of sensory or mobility impairments. What follows is a broad and somewhat selective overview of devices commonly being introduced into school settings.

Augmentative Communication

Augmentative communication devices help individuals in producing and/or understanding speech. The technology can range from a board with pictures representing a student's daily needs to sophisticated electronic speech synthesizers. Speech

output devices may be simply devices for storing and playing back prerecorded speech or may be true speech synthesizers that use segments of words, called diphones, to produce words. Computers can be equipped with speech synthesizers, and there are portable electronic devices that can produce speech. The impact of an augmentative communication device on a person with a speech impairment can be dramatic. Until two years ago, 15-year-old Bobby Hussion of Austin, Texas, who has cerebral palsy and no speech, had been diagnosed at a one-year-old level of functioning. He was in a self-contained program in middle school. Recently he obtained a computer with text-to-speech capability and a touch screen through Community Living Assistance and Support Services (CLASS), a Texas Department of Human Services program designed to help students like Bobby stay in their home communities rather than live in an institution. Today he is writing short sentences and playing games on the computer. His new-found ability to communicate his needs has done much to reduce his frustrations with daily living. His mother finds that people talk to Bobby instead of around him like they used to. She says, "I think everybody has a totally different view of where he's at and how appropriate he is for his age and how much he really understands." Bobby entered his home high school this year, and his individualized educational program has been changed to include academic objectives and inclusion in two regular classes. **Adaptive Computing**

Students with physical or sensory disabilities may not be able to make use of a computer because of their impairments. Students with mobility impairments may have no problem reading a computer screen but may not be able to type or input information without adaptive hardware. Such devices include expanded keyboards, where the keys are larger and further apart, joysticks in place of a mouse, keyboards adapted for use with just one hand, and input through blinking an eye or blowing on a switch. For students who are blind, Braille input and output devices are available. Since text-only computer output would be a barrier for a blind student, text-to-speech software can be used. Earphones for students using voice output can eliminate distractions for others. Students with milder vision impairments may benefit from computer software that can enlarge portions of the screen.

Assistive Technology for Students with Learning Disabilities

Despite adequate cognitive ability, learning disabled students' difficulties with basic skills such as reading and writing can prevent full participation in the classroom and later in critical

adult life activities. Computer technology provides the answer for many of these students.

Recent advances in computer technology have much to offer students with learning disabilities, both as tools for instruction in school and as tools for life that can be used to compensate for specific impairments. For years, teachers of the learning disabled have searched for means to help students compensate for their inability to master certain skills. Despite adequate cognitive ability, learning disabled students' difficulties with basic skills such as reading and writing can prevent full participation in the classroom and later in critical adult life activities. Computer technology provides the answer for many of these students. A student with dysgraphia (i.e., inability to produce legible handwriting) can use a computer with a word-processing program to alleviate much of this problem. Students with severe problems in spelling can functionally compensate using spell checkers and on-line thesauruses. Word prediction programs that can anticipate words from a few letters can increase both accuracy and speed of input. Students who have severe reading problems can use a computer in much the same way students with visual impairment do-through enlarged print size or voice synthesis. Computer technology can provide the kind of drill and practice that many students with learning disabilities need to help them develop fluency in such areas as mathematics facts and reading decoding. Additionally, software programs provide the multisensory and interactive experiences that can be so important for students who are easily distracted. Another kind of software that can help a student who has writing problems is organizational software. These programs help users through processes such as outlining and concept mapping. Although not necessarily developed for students with learning disabilities, the programs can be very helpful for students who have difficulty organizing and synthesizing information.

Assistive Technology in Action

As most experienced educators know, students, including students with disabilities, seldom come to school with clear-cut needs that fit concisely into certain categories. Many students with disabilities will benefit from an array of assistive devices, which will require extensive collaboration among people from different fields and agencies. However, the rewards can be great for the student and all of the other individuals involved. Bryan Ayres of the Arkansas Easter Seal Outreach program describes six-year-old Jonathan Duckworth, who is in a regular classroom in the small rural community of

Hoxie in northeast Arkansas. Jonathan is a bright, inquisitive student who has cerebral palsy and uses a number of assistive devices, including an augmentative communication device (a TouchTalker), several kinds of mobility equipment, and adaptive utensils for eating and drinking. When Jonathan was old enough for school, his parents wanted him to be able to participate in public school classes and to be able to interact effectively with his peers. Hoxie Elementary School had never served a student using the variety of assistive devices that Jonathan needed. Rhonda Smith, the school's principal, and Rita Branch, the assistant principal, both had concerns about adequately meeting the needs of both Jonathan and his peers in the same school setting. However, after two years in an inclusive setting, everyone who is involved agrees that he is in the right program and the right placement. With the cooperation of a committed special-education support team and excellent support from the Duckworth family, Jonathan's goal of an integrated, high-quality public education became a reality.

Assistive Writing

Speech recognition is often considered as an assistive writing tool for people with Learning Disabilities such as:

Dyslexia-- a language-based disability in which a person has trouble understanding words, sentences, or paragraphs.

Dysgraphia-- a writing disability in which a person finds it hard to form letters correctly or write within a defined space.

A person planning to use speech recognition must be aware he is required to go through an enrollment (training) session. This is a one time reading when the user must read aloud an excerpt of text that is displayed during the training feature of the speech recognition application. (For an example of enrollment text, please see What Is Speech Recognition) Depending upon the speech recognition software, there are several enrollment training excerpts to select from.

I use a technique of assisting people with poor reading skills through the initial enrollment training of speech recognition. I call this technique parrotting. When parrotting, I read aloud the enrollment text in phrases, consisting of between 3-6 words, and the speech recognition candidate repeats the words I have just spoken.

There is no single determination if speech recognition will, or will not, be appropriate technology for someone with a learning disability. I have learned that there is a degree of

motivation required if speech recognition to be used as a writing tool.

I have found that the initial enrollment training, and the (dictation) training afterward to be a key factor to prevent Assistant Technology abandonment.

It's very important to have no delay when dictating, and seeing the word(s) displayed on screen. No delay, and the user is more likely to notice words that have been misrecognized (words misinterpreted by the speech recognition software). This can be accomplished using a high-end computer system: Pentium 4 processor, 2.2 GHz, 12MB RAM

The user must cope with the following when considering speech recognition as a successful writing tool:

- basic computer skills,
- word processing skills,
- dictation skills,
- when/how to use speech recognition commands, and last, but not least—
- MOTIVATION.

A comparison using speech recognition.

Think of each of the five skills I mentioned above, as a single strand of string. When intertwined, the strands of string become a strong rope. But-- the rope will (snap) if one or more of these strands of string is frayed.

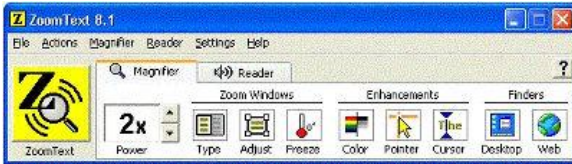
| AAC | Vision | Cognitive |

Screen Magnification for Low Vision

ZoomText Xtra Level 2 by AI-Squared

Integrated Magnification and Screen Reading

Zoomtext 8.1 has two new features for easily reading. Fractional magnification, is now available in powers of 1.25x, 1.5x and 1.75x. And, in Windows XP, ZoomText's AppReader can read PDF documents using Adobe Reader 6.0.1 or later. ZoomText Xtra Level 2 features synchronized magnification and screen reading that's easy to use. Level 2 speaks all on-screen text, echoes typing and automatically reads multi-page documents.



Pricing InfoSupernova by Dolphin Computer Access

Combines magnification, speech and Braille output in one program. This is to benefit individuals and establishments with a range of visually impaired requirements. Fully integrated magnification, speech and Braille MAGic v8.0 by Freedom Scientific

A screen magnification program, it contains high and true color support (up to 32-bit) for enhanced smoothing of characters. The only magnification software to work with the powerful program for blind-- JAWS for Windows screen-reading software. BIGGY by RJ Cooper & Associates

Finally, BIG, ultra-visible cursors for all programs. Large selection, even 'lefties'. Many are even animated PLUS, other SIGNIFICANT cursor enhancements also. Biggy also lets you choose big & bold replacements for cursors, like the I-beam. A great all-around utility that works within any software.

What kinds of assistive technology tools are available?

The term "assistive technology" has usually been applied to computer hardware and software and electronic devices. However, many AT tools are now available on the Internet. AT tools that support kids with LD include:

- Abbreviation expanders
- Alternative keyboards
- Audio books and publications
- Electronic math work sheets
- Freeform database software
- Graphic organizers and outlining
- Information/data managers
- Optical character recognition
- Personal FM listening systems
- Portable word processors
- Proofreading programs
- Speech-recognition programs
- Speech synthesizers/screen readers
- Talking calculators
- Talking spell checkers and electronic dictionaries
- Variable-speed tape recorders
- Word-prediction programs

Reference

- <http://www.abilityhub.com>
- <http://www.greatschools.org>
- <http://www.sedl.org>