

Assistive Technologies for Physically Handicapped Persons

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Abstract. People with physical disabilities have limited capabilities in moving, performing manual tasks and taking participation in some life activities. Muscular dystrophy, multiple sclerosis, spinal cord injuries, head injuries, amputations, arthritis, etc., are some causes of physical disabilities. Since that physical impairments can significantly make tedious, even in some cases quite disable using of information technology, it is required to make adaptations that will be enabling the full communication with computers by persons with this kind of disabilities. In this article, some issues about communication between computers and persons with physical impairments are discussed, and are presented a review of available assistive computer technology that make this communication possible. As information education is fundamental education in modern society, the special accent is given to the communication problematic between physically handicapped persons and computers.

Keywords. Physical Disabilities, Assistive Technology, Orthopedic Disabilities, Alternative Devices

I INTRODUCTION

A wide variety of disabilities result in physical impairments, and can range in severity from limitations of stamina to paralysis [1][2]. Physical disabilities can be present at birth, while others are the result of illness or injury. Quadriplegia refers to the loss of function in arms, legs and trunk areas. Individuals with quadriplegia have limited use of their arms and hands and little or no use of their legs. Many require motorized wheelchairs. Arthritis causes inflammation in the body's joints, resulting in pain and mobility difficulties. Back disorders hamper the individual's ability to sit, stand, walk, bend or carry objects easily. Cerebral palsy is the result of brain damage before or shortly after birth; it may result in speech difficulties, walking problems, spasms and lack of muscle coordination.

TABLE I

INCIDENCE OF SOME COMMON ORTHOPEDIC IMPAIRMENTS
IN USA

Impairments	Incidence
Spina Bifida	6 per 100.000 births
Spinal Cord Injury	approx. 11.000 cases per year
Muscular Dystrophy	1 in 651.450 or 417 people in USA
Native / Acquired Limb Deficiencies	1 in 4.400 people annually
Arthrogryposis	1 in 3.000 live births

Each physical disability results in different levels of physical difficulties, and individuals vary in the way the disability affects them. Physical disabilities can either be permanent or temporary but will affect how an individual accesses the CAP site and the computer workstation. For example, an elevator or ramp provides access to spaces when a staircase is insurmountable for someone who uses a wheelchair. Similarly, specialized hardware or software, called assistive or adaptive technology, allows people with physical impairments to use computers. These tools allow a person with limited, uncontrollable, or no hand or arm movement to successfully perform in school and job settings. Adaptive technology can allow a person with a physical impairment to use all of the capabilities of a computer. Special input devices for users with physical disabilities will depend on the user's specific impairment; numerous assisting devices are available. The potential for great benefit to people with different kind of disabilities is one of the unfolding gifts of computing.

Given the growth of disabled population expected in the future, the challenge for designers of information systems are the issues of both accessibility and functionality. There are a wide range of available assistive technology solutions on the today's computer market. In this paper is tried to present the

comprehensive review of adaptive computer equipment and to point out the innovative high-tech solutions.

II COMPUTER ACCESS FOR PEOPLE WITH PHYSICAL DISABILITIES

Common supports and accommodations for people with physical disabilities in the CAP sites might include accessible parking, priority registration, accessible facilities, lab or computer assistants, simple adaptive computer technologies (such as key guards), consideration of workstation set-up and note takers during lessons.

A variety of issues must be considered before addressing access to the computer for people with physical impairments. These include seating and posture, work surface, lighting, temperature, vibrations, noise, ventilation, keyboards (information input) and mouse access, monitor (information output) and accessories.

Computer access for people with physical disabilities may be achieved through:

- keyboard adaptations,
- alternative keyboards,
- an expanded keyboard,
- a mini keyboard,
- mouse alternatives, and
- assistive technology software.

Simple solutions include the modification of key repeat rates and sequential keystroke selection. Keyboard macros allow the user to assign a few keystrokes to perform functions that would normally take multiple keystrokes. Word prediction software limits the number of keystrokes required to enter words and phrases.

Keyboard adaptations can be made with hardware or software. Hardware includes key guards and key locks. Software adaptations include Easy Access (Mac) and Access DOS (IBM) alternative keyboards, including PowerPad, Big Keys Unicorn Expanded Keyboard, Intellikeys, TouchWindow and on-screen keyboards, Tash Minikeyboard, KeyLargo, chordic keyboards, Braille keyboards, and so on. Some alternative keyboards plug into the serial ports of any computer (Intellikeys). Other devices (Unicorn Expanded Keyboard) require additional equipment.

More involved physical disabilities require alternative input, including:

- the TongueTouch Keypad,
- single-switch on-screen keyboard access with scanning,
- single-switch access using Morse code,
- voice recognition software,
- head mouse/head master and pointing devices,
- JOUSE - a joystick-operated mouse controlled with the mouth,
- voice input,
- eye gaze technology,
- head wands or Sip N' Puff, and

- on-screen keyboards with regular or alternative mouse access (track pads, joysticks, trackballs).

III ASSISTIVE TECHNOLOGIES FOR PERSONS WITH ORTHOPEDIC DISABILITIES

Orthopedic disabilities can result from many causes such as accidents, strokes, birth defects, viral infections and neurological disorders. The range of physical impairment that result from such disabilities is enormously varied. This section addresses the access consideration of persons who can press all of the keys on a standard computer keyboard using either their fingers, a hand, head or mouthheld pointing device, toes or other body extremity [4][5][6].

For persons with disabilities that affect the upper body, productive use of computers should address three critical issues: keyboard positioning, keyboard access and typing speed.

III.A Keyboard Positioning

The keyboard can be the biggest obstacle to computing for a person with a physical impairment. 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. Correct keyboard positioning will allow persons with moderate levels of orthopedic disability to minimize physical exertion and thus reduce fatigue. Properly positioned keyboards also help to decrease the spasticity and resultant keyboarding errors that occur from straining to reach portions of the keyboard. Repositioning the keyboard to the floor can allow someone to use his feet instead of his hands for typing.

III.B Keyboard Access

Assistive technologies that provide keyboard access are vitally important. The multiple keystroke commands common to many computer applications can be an obstacle for persons with virtually any degree of orthopedic disability. How, for example, can a one-handed typist or headstick user, hold down a key on the left-hand side of the keyboard while simultaneously pressing another key on the right-hand side of the keyboard?

III.C Specialized Adaptations to Control Keyboard Functions

One of the most useful access tools available for individuals with orthopedic disabilities are programs that provide control of keyboard operation. If physical disabled computer users find that using the standard keyboard works for them but that some aspects are slowing them down, then keyboard modification software may be just what they need. For many disabled persons, use of such an adaptation may be all that is required to gain computer access. Programs of this type should meet the criteria that follow.

Such assistive tools should be utility programs that can be easily loaded into the computer. Keyboard modification software allows users to keep using their ordinary keyboard, but