ICT and Persons with Disabilities: The Solution or the Problem?

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Technology and progress

- Progress requires change
- Much change is accomplished through advances in technology
- Technology also creates problems:
  - over consumption,
  - environmental ruin,
  - separation of classes
- These are amplified for people who have disabilities => a “disability gap”
- Principle of distributive justice

Ronald Wright, *A Short History of Progress*, Anansi Pub, 2004
What can we expect from technology in the next 20 years?

- Automated transactions between individuals and organizations
- Equalized access to the web and information between developed and developing world
- Embedded systems – “intelligence in your doorknob or phone”
- Much greater understanding of the biological/physical interface for the control of ICT
Traditional display technology for communication devices
Examples of Emerging Mainstream Technologies with potential for AT

- Direct retinal display - creates image that overlays view of real object (IEEE Spectrum, May 2004)
Examples of Emerging Mainstream Technologies with potential for AT

- 3-D displays that create a more intuitive view of objects, events and activities
- Embedded ASR in PDA to reduce need for keyboards with more and more functions
Focus on People-the Rehabilitation Engineering Difference
Technology advances can increase the gap between people who have disabilities and those who don’t

- The ability to make tools is what distinguishes us as human, but...
- Our tools ultimately control us by making us dependent on them, and...
- This dependence is less optional for people who have disabilities

Ronald Wright, *A Short History of Progress*, Anansi Pub, 2004
Implications for Assistive Technologies

- Constant challenge to keep tools and systems accessible to persons with disabilities (PWD)
- Must be driven by needs of PWD
- Must be functional in many contexts without technical support
Physical Contexts

Public Park

School classroom

Public buildings

Store

Crowded elevator

Home
Social Context

- Strangers
- Co-worker
- Teachers
- Family
- Friends
Institutional Context

- Societal organizations responsible for policies, decision-making processes and procedures
- World Health Organization ICF:
  - Services
  - Systems
  - Policies
- Funding is most influential element
  - eligibility to receive devices purchase assistance
  - devices that are supported in funding scheme
  - funding gatekeepers
- Governments also regulate and support environmental modifications for persons with disabilities
Access to capabilities of mainstream technologies: information systems

- Universal Design
- Individualized assistive technologies - customization
Universal Design

The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.

© 1997 NC State University, The Center for Universal Design
Access to capabilities of mainstream technologies: information systems

Universal Design for ICT
Features of Future Information Services*

- No clearly predefined service – Access to information involving communities of users
- Varied contexts of use
- Services are:
  - Highly interactive
  - Inherently multimedia
  - Sensory multimodal

* PL Emiliani, Tech Disab, 18, 19-29, 2006
Universal design for IT

- Barriers are technological
- Contrasts with architectural universal design which has political and economic barriers
- The goal is to have an environment with enough embedded intelligence to be easily adaptable
Expanded availability of embedded systems

- Open architecture that allows downloading profiles for AAC
Expanded availability of embedded systems

Trainable hearing aids that adjust automatically to the environments in which they are used
Expanded availability of embedded systems

Downloading instructions and grocery list to PDA for a person with intellectual disability based on sensing of location.
A Working Definition of Assistive Technologies*

Any item, piece of equipment or product system whether acquired commercially off the shelf, modified, or customized that is used to increase, maintain or improve functional capabilities of individuals with disabilities.

*United States (Public Law (PL) 100-407)
Hard and soft technologies*

- **Hard technologies:**
  - readily available components
  - can be purchased and assembled into assistive technology systems
  - main distinguishing feature is that they are tangible

- **Soft technologies:** human areas of decision making, strategies, training, concept formation

Approaches to AT devices: commercial, modified and custom

<table>
<thead>
<tr>
<th>Commercially Available</th>
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<tbody>
<tr>
<td>Standard (for general population)</td>
<td>Special (for disabled population)</td>
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Modified

Custom

*From Cook and Polgar, (2007)*
Human Technology Interface: Technology Access for individuals with motor limitations
HAAT Model*

*From Cook and Polgar, (2007)
Keyboards for direct selection

Touch screen

Contracted keyboard

Enlarged keyboard
Alternative Mouse Devices

- Trackball
- Mouth controlled (Jouse)
- Head mouse-reflective dot
Brain Computer Interface

BCI SYSTEM

SIGNAL ACQUISITION → DIGITIZED SIGNAL → SIGNAL PROCESSING

Feature Extraction → Translation Algorithm → DEVICE COMMANDS

Brain

Devices:
- Wheelchair
- Bottle
Rehabilitation robotics
Rehabilitation robot with vision
Cognitive Assistive Technologies

Assistive technologies that meet needs for participation by individuals with:

- Intellectual disabilities
- Learning disabilities
- Memory loss
- Dementia
Cognitive AT

PDA used as prompt for procedures

Alternative time system-1/4 hour watch displays 15 minute increments to a pending event shown on picture card

Wall mounted daily task planning aid
Cognitive AT

The Planning and Execution Assistant and Trainer (PEAT)*

PDA-based Artificial intelligence (AI) generates plans

*Attention Control Systems, Mountain View, CA, www.brainaid.com/
Cognitive AT

- Processing & communication system linked to sensor array
- Assesses occupants current state and the state of various home utilities to aid with common ADLs
- Provides feedback should residents become disoriented or confused
- Automatic notification of medical problems based on physiological monitoring

Smart House
Sensory aids
Sensory aids

- Auditory
  - Hard of hearing
  - Deaf
- Visual
  - Low vision
  - Blindness
Conventional Hearing Aids
Bone anchored hearing aid
Cochlear Implant
Cochlear Implant - signal processing
Sensory aids

- **Auditory**
  - Hard of hearing
  - Deaf

- **Visual**
  - Low vision
  - Blindness
Readers for individuals with low vision

Portable unit

Digital desktop unit
Reading aids for people who are blind

Portable Braille note taker

Paperless Braille displays

Digitally recorded books
The Infrastructure for Future Accessibility

- Web-based virtual systems
- Home automation
- Universal design
- Alternatives for accessing information technologies
- Special-purpose assistive technologies
**What We Know for Sure**

- Systems will be faster, have more memory and be less expensive for the same capability
- Materials will continually be improved to be lighter, stronger and more durable
- System size will continue to shrink
- Communication channel bandwidth will continue to rise
What We Aren’t So Sure About

- Whether accessibility will keep pace
- Whether the needs of persons with disabilities will be a driving force
- What the negative aspects of technologies will be in the long run
Future Options for Persons with Disabilities

- **Modify the tool - AT**
- **Modify the environment - universal design**
- **Modify the person - neural engineering**
- **It is less important to redistribute wealth than it is to redistribute opportunity** - Arthur H. Vandenberg
The future for persons with disabilities

Will not be driven by advances in technology, but rather ...

by how well we can take advantage of those advances for the accomplishment of the many tasks of living that can benefit from technological assistance