What is assistive technology?

- Application of technology to compensate for loss or lack of physical, sensorial, or cognitive functions
- Assists people with disabilities in their activities in life
- Examples: http://www.enablemart.com/

Some examples

Universal design vs. assistive technology

Why an important class of systems

- Impact of aging in America over the next decade
  - Over 70 million baby boomers
  - Controlling $9 trillion in assets
  - Will start to acquire significant disabilities
- Similar effect to be expected in Canada, U.K. & Australia
Why Accessibility is Important

- The accessible internet has allowed for a significant amount of independence for the individuals with disabilities
  - Online shopping + delivery
  - Public transit information
  - Access to information and media
  - Accessible education through distance learning
  - Increased opportunities for employment

It’s the Law!

- Americans with Disabilities Act
  - Passed in 1990
  - Made it law to provide accessible bathrooms, curb cuts for wheelchairs, elevators in public buildings, etc.
- Rehabilitation Act of 1973
  - Section 508 – Amended 1998 - Mandates that all federal agencies have accessible electronic and information technologies
  - Similar laws in other countries

Types of Disabilities

- Visual impairments
  - Including blindness, various common types of low vision and poor eyesight, various types of color blindness
- Motor/Mobility
  - E.g. difficulty or inability to use the hands, including tremors, muscle slowness, loss of fine muscle control
- Cognitive/Intellectual
  - Developmental disabilities, learning disabilities and cognitive disabilities
- Auditory
  - Deafness and hearing impairments
- Seizures
  - Photoepileptic seizures caused by visual strobe or flashing effects

Common ways of interacting with computers

- Input
- Output

Range of physical impairments

- Complete lack of function
- Absence of a limb
- Paralysis – usually due to spinal injury, the higher the damage the greater the degree of paralysis
  - Tetraplegia / quadriplegia – all four limbs
  - Paraplegia – lower limbs only
- Lack of strength
- Tremor / lack of accuracy
- Slowness

Keyboard modifications

- Keyguards
- Alternative layouts
  - Reduce movement
  - One-handed keyboards, possible chords
  - Membrane surfaces (minimize required pressure)
**Software modifications**

- Sticky keys
- Slow keys or disable auto-repeat
- Modify keyboard mappings
- On-screen keyboards

**Alternate text input**

- Switches
  - Keyboard has approximately 50 switches
- Speech input
  - Dictation versus control
- Pen input
  - Handwriting recognition
  - Gesture recognition
  - Software keyboards

**Possible switches**

- Foot pedal
- "Leaf" switch – highly sensitive
- Sip and puff
- Joystick
- Muscle switch
- Neural implant
- Eye gaze

**Other hands-free interaction**

- Sip & Puff
  - [http://www.youtube.com/watch?v=Ao8p2PlzkjU](http://www.youtube.com/watch?v=Ao8p2PlzkjU)
- Brain-Computer Interface
  - Text
    - [http://www.youtube.com/watch?v=4QxPR25DMAg](http://www.youtube.com/watch?v=4QxPR25DMAg)
  - Mouse:
    - [http://www.youtube.com/watch?v=NIG47YgndP8](http://www.youtube.com/watch?v=NIG47YgndP8)

**Scanning interfaces**

(a) ![Matrix A](image1)

(b) ![Matrix B](image2)

(c) ![Matrix C](image3)

(d) ![Matrix D](image4)

**Speech recognition challenges**

- Speaker independent / dependent
  - Parametric patterns are sensitive to speaker
  - With training (dependent) can get better
- Discrete or continuous
  - Continuous: where words stop & begin
  - Typically a pattern match, no context used
- Vocabulary size
  - Some have 50,000+ words
  - Bigger is not necessarily better...why?
One-handed ways to enter text

Quickwrite
- Developed by Ken Perlin
- Unistroke recognizer
- UIST'98 paper

http://mrl.nyu.edu/projects/quickwriting/

Cirrin
- Developed by Jen Mankoff
- Word-level unistroke technique
- UIST '98 paper
- Use stylus to go from one letter to the next

http://depts.washington.edu/ewrite/

EdgeWrite
- Developed by Jacob Wobbrock
- Unistroke technique
- UIST '03 paper
- Addresses tremors
- Supports eyes-free interaction

Mouse alternatives
- Trackball
- Proportional joystick
- Switched joystick or cursor keys
- Head sensor or mouth stick
- Eye-gaze
- Keyboard only

Using audio to point or navigate
- Voice as sound: using non-verbal voice input for interactive control
  - Igarashi & Hughes
  - UIST 2001
  - Video: http://www-ui.is.s.u-ko.ac.jp/~tabek/research/voice/voice.htm
- Blui: low-cost localized blowable user interfaces
  - Patel & Abowd
  - UIST 2007
  - Video: http://www.youtube.com/watch?v=345EmM3hNlQ
Using audio to point or navigate

- Voice Draw
- Susumu Harada, Jacob O. Wobbrock, and James A. Landay

Vision

- The vast majority of visually disabled people have some sight
  - Low-vision
  - Color blindness
  - Blindness

Accommodating blind users

- Capture and model graphical interface
- Translate graphical objects
- Support efficient and intuitive interaction
- Screen readers
  - Full-featured
  - Cursor-tracking, routing
  - Dialogue focus
  - View areas
  - MS demo

Input/Output

- Keyboard plus screen reader
  - http://www.youtube.com/watch?v=ByW0vR0nxM
  - http://www.youtube.com/watch?v=IK97XMibEws
- Braille Input Keyboard
  - http://www.youtube.com/watch?v=6z6v5bFm46c
- Speech Recognition

Sensing

- Color Detectors
- Money Scanners

Deafness

- Communication aids
  - Sign language
  - Speech training
  - Writing aids
Sign language

- Sign languages are true languages
  - Syntax, semantics, pragmatics
- Differ dramatically from oral-based languages
- Many different sign languages
  - American (ASL) close to French Sign Language but different than British (BSL)
  - Signed Exact English for one-to-one translation

Minicoms & TDDs

- "Universal" telephone technology
- Text terminal (keyboard, LED display, modem)
- Deaf relay centers
  - TypeTalk
  - Automation?

Computing assistance

- Translators
  - Speech to sign
  - Sign to speech
    - Gesture recognition
    - Need sign language grammars
  - Video phones
- Word processors (Write This Way)
- Speech training (Speech Viewer, IBM)

Speech synthesis

- Quality of synthetic speech
- Similarity to human speech

Example: Scribe4Me

Mobile ASL

- Sign language over mobile devices
  - Anna Cavendar,
  - Richard Ladner,
  - Eve Riskin,
  - Jacob Wobbrock

- http://mobileasl.cs.washington.edu/
**Sign Language Recognition**

- Using sensors for detection sign language signs, which can be spoken aloud by a speech synthesizer
- Georgia Tech
  - Thad Starner, Helene Brashear, Valerie Henderson-Summit
  - [http://www.cc.gatech.edu/fac/Thad.Starner/031_research.htm](http://www.cc.gatech.edu/fac/Thad.Starner/031_research.htm)

**Cognitive impairments**

- Memory
  - Short or long term, recall and recognition
- Perception
  - Attention, discriminating sensory input
- Problem-solving
  - Recognizing the problem, implementing solutions and evaluation
- Concepts
  - Generalizing, skill development
- Language impairments
  - dyslexia (spelling corrector)
  - aphasia (symbolic languages)

**Common causes**

- Head injury or stroke
- Alzheimer's
- Dementia
- Aphasia
- Autism

**Example: Wayfinding**

- UW
  - [http://cognitivetech.washington.edu/](http://cognitivetech.washington.edu/)
  - [http://www.senderogroup.com/wayfinding/about.htm](http://www.senderogroup.com/wayfinding/about.htm)
- U. Colorado at Boulder
  - Mobility for all
  - [http://l3d.cs.colorado.edu/research/projects.html](http://l3d.cs.colorado.edu/research/projects.html)

**Example: Visual Aids**

- Visual pictures & schedules
- Picture Communication

**Autism**

- Many individuals are non-verbal and have difficulty communicating
- Focus has been on assisting with data collection for assessing skill progress or determining causes of behaviors
Abaris
• Capture & Access system designed to help autism therapists track progress in learning skills

CareLog
• After-the fact capture and annotation

Sensing Stimming Behaviors
• Can help caregivers understand when a non-verbal child is experiencing high levels of stress

SenseCam
• Can help parents view what a child has done throughout their day

Good things to know
• Many assistive technologies are abandoned
• Assistive technologies are often very expensive for users
  • Low production, health insurance covers it...
• Must be designed for long-term use
  • Health insurance may only pay to replace devices once every 10 years

Mobile Devices
• Way of the future?
• Cheap, high tech, high capabilities, highly mobile
• Bertini & Kimani
  • Aids to carry out functions
  • Communication devices
  • Assistants
  • Non-conventional interactions
  • Democratization
Mobile phones & deaf

- Most significant new communication device for deaf is mobile phone with sms
  - Sidekick

Mobile phones & blind

- Screen readers for mobile phones
- Accessible iPhone
  - Kane & Wobbrock

Want more? Take my class!

- INSC 546 - Assistive Technology and Inclusive Design
  - Grad-level class
  - Project oriented, reading, discussions
  - Guest lectures
- Spring 2010
  - Tuesday & Thursday 2:30-4:20
  - [http://courses.washington.edu/insc546/](http://courses.washington.edu/insc546/)

More Info

- Watch the “Curb Cuts” Episodes on YouTube
  - Episode 1:
    - [http://www.youtube.com/watch?v=u3S3Wpobow](http://www.youtube.com/watch?v=u3S3Wpobow)
- AssistiveWare Videos