January 30, 2024

Brain-Computer Interfaces for Communication

ENGR110/210
Perspectives in Assistive Technology

Erin M. Kunz, PhD Candidate

Stanford University

Questions, Comments, Suggestions, or Concerns?

Please notify me of your comments, suggestions, and concerns so I can explain / address / correct them.

Celebrities / Famous People

- Tom Hanks
- Steph Curry
- Elon Musk
- Jerry Seinfeld
- Jennifer Lopez
- Reese Witherspoon
- Naomi Campbell
- Geena Davis
- Paul McCartney
- Luke Bryan
- Ted Kennedy
- Alan Cranston
- S I Hayakawa
- Ray Kurzweil
- Neil Young
- Bob Weir (Grateful Dead)
- Mel Torme
- Joe Simitian

Upcoming class sessions

- The Third Arm Project –
  J. Kenneth Salisbury, Jr., PhD - Thu, Feb 1st
- Issues of Human Interface Design –
  Gary M. Berke, MS, CP, FAAOP - Tue, Feb 6th
- Assistive Robotics –
  Monroe Kennedy III, PhD - Thu, Feb 8th
- Mid-term Student Project Presentations –
  Tue, Feb 13th

Teams

- Team Re-Creation - Accessible and Inclusive Playground Attractions
- Team ArtSIStive - Creative Expression for Danny
- Third Team with No Name - Dog Kennel for Danny & Korey
- Fourth Team with No Name - Storage Solution for Danny
- Danny Designers - Laptray for Danny
- Dream Catchers - Accessible and Inclusive Playground Attractions
- Secure the Bag - Accessible Storage Solution for Abby
- Eighth Team with No Name - Treats for Nathan

Team Activities

- Work as a team together on all activities
- Understand the Problem / Challenge - search web for existing products
- Brainstorm possible solutions
- Evaluate design concepts with Pugh Chart
- Sketch ideas & Fabricate low-cost prototypes
- Discuss and demonstrate the prototypes with the project suggestor
- Receive and analyze their feedback and suggestions
- Redesign and fabricate a refined prototype
- Iterate this process until the end of the quarter
- Take photos of team activities
- Report your project progress as a team
- Meet with me / Henry

Students working on Team Projects

- Decide on a cool team name
- Start preparing for Mid-Term Presentation and Report
- **Sign up for PRL Safety Orientation**
- Weekly - Meet with me or Henry to report on project progress
- Submit progress reports
- Read Week in Review emailings
- **Do not hesitate to ask questions about your project direction**

Selecting Design Concepts

- Select best design concepts using a Pugh Chart
  - Plot best brainstormed design concepts vs design criteria
    - Ability to meet requirements & criteria
    - Prototype fabrication cost and time
    - Complexity (consider fabricators' skill level)
    - Ability to complete within allotted time and budget
    - Caregiver / User issues
  - Weights - which criteria / features are most important?

Pugh Chart 1

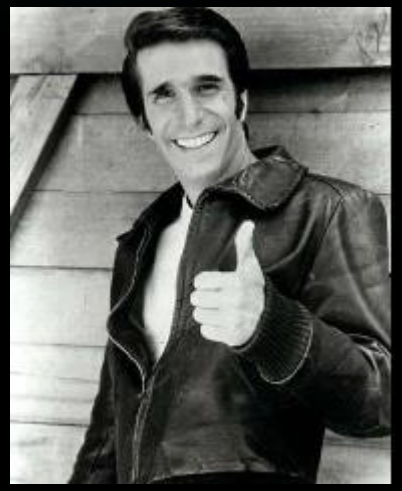
Criteria for Success		Option 1		Option 2		Option 3	
Common Theme	7	7	49	6	42	10	70
Expands Knowledge	5	5	25	3	15	7	35
Accurate Info	9	8	72	8	72	7	63
Appealing	8	6	48	9	72	7	56
Unique	10	9	90	6	60	6	60
3 different forms of media	10	9	90	7	70	8	80
Reflects Rauschenberg	4	7	28	10	40	6	24
	TOTAL	402		371		388	

Selecting Design Concepts

Don't forget aesthetics and coolness factor

- Users won't buy or use a products that identifies them as disabled
- Users want to look cool
- You want to work on something cool

Description		Kimberly Clark Paper Towel Dispenser	Side Roll	Paper Quantity Sensor	Clear Windows	Free-Standing w/ Recycling	Foot Pedal
Sketch							
Criteria	Weight	Datum	Design 1	Design 2	Design 3	Design 4	Design 5
Reliability	2	0	-	0	0	0	-
Hygiene	3	0	-	0	0	0	-
Ease of Use	3	0	-	0	0	-	-
Safety	2	0	0	0	0	0	0
Durability	1	0	0	0	0	0	0
Aesthetics	1	0	-	0	-	--	-
Ease of Replacement	1	0	0	+	+	0	0
Environment	2	0	0	0	0	-	--
+		0	5	1	1	2	6
0		15	6	15	13	9	4
-		0	4	0	1	2	7
Net Score		0	1	1	0	0	-1



Pugh Chart 2

Description		Kimberly Clark Paper Towel Dispenser	Side Roll	Paper Quantity Sensor	Clear Windows	Free-Standing w/ Recycling	Foot Pedal
Sketch							
Criteria	Weight	Datum	Design 1	Design 2	Design 3	Design 4	Design 5
Reliability	2	0	-	0	0	0	-
Hygiene	3	0	-	0	0	0	-
Ease of Use	3	0	-	0	0	-	-
Safety	2	0	0	0	0	0	0
Durability	1	0	0	0	0	0	0
Aesthetics	1	0	-	0	-	--	-
Ease of Replacement	1	0	0	+	+	0	0
Environment	2	0	0	0	0	+	--
+		0	5	1	1	2	6
0		15	6	15	13	9	4
-		0	4	0	1	2	7
Net Score		0	1	1	0	0	-1

Students working on Team Projects
Mid-term Presentations in two weeks!

- Mid-term presentations will be **8 minutes**
- Project title, background, problem, aim, design criteria, "understanding the problem", existing products, brainstorming activities, sketches, prototypes, and selected solution(s)
- PowerPoint slides - Google Docs
- Strive to be professional
- Include feeling & emotion in presentation
- Presentation tips on course website
- Signup Sheet for presentation order will be available in class next Tuesday

Students working on Team Projects
Mid-term Report

- Mid-term report - 10 to 15 pages of narrative and images
- Include legible sketches and photos
- Goal: short, concise, well-written, and highly readable report with few grammatical and spelling errors.
- Report Writing Tips webpage documents suggested report features

Students working on Team Projects
Extra Credit: Ask AI Report

- Another source of "Understanding the Problem" is AI. While the results may not be perfectly useful, AI could provide interesting suggestions to consider.

- So, for this extra credit assignment, Ask AI (such as ChatGPT) to suggest solutions to the user's challenge. Document the queries used, the responses, and your assessment of their value. The report should be no more than two pages long. The due date is TBD.

Student working on an Individual Project

- Submit project name
- No mid-term presentation
- Contact me if you have questions about your project direction
- Weekly - Meet with me to report on project progress
- Submit progress reports to me

Reminder - Work with Diligence

- Time is your team's most precious resource
- 2 weeks of class until Mid-term Presentations - Tue, Feb 13th
- It is not too early to outline your presentation & report

Overview of Accessibility

A11y

What is Accessibility?

Accessibility is a:

- Property
- Design concept
- Design specification
- Design consideration
- Design goal
- Product feature

Properties: Readability, flexibility, visibility, permeability, drivability, durability, flammability

What is Accessibility?

That enables people:

- Individuals with disabilities:
  - Sensory
  - Physical
  - Cognitive
  - Neurological
  - Temporary
- Older adults
- Kids
- Everyone

What is Accessibility?

To better interact through:

- Sight
- Sound
- Touch
- Smell
- Mobility
- Understanding
- Communication
- Manipulation
- Teaching / learning

What is Accessibility?

With the real world:

- Other people
- Infrastructure:
  - Buildings
  - Institutions
  - Transportation systems
- Products:
  - Computers
  - Internet
  - Websites
  - Household items
  - Office items

What is Accessibility?

Through an enhanced hardware and / or software user interface:

- Alternate ways
- Augmented ways
- Customized ways
- Preferred ways

What is Accessibility?

For these purposes:

- Education
- Vocation
- Recreation
- Daily living

Little Things Do Make A Difference

Little Things Do Make A Difference
Little Things Do Make A Difference
Little Things Do Make A Difference

The Goal of Accessibility

The ultimate goal of the accessibility movement is to ensure that everyone - regardless of ability or disability - has an equal chance to participate in society. In the face of constant technological change, this becomes more difficult but also extremely necessary. The only way to allow people with disabilities to engage fully in the activities that interest them is to give them access to all the possibilities open to everyone else, including those offered by twenty first century technology.

Accessible Technology in the 21st Century

- The Future

Examples of Devices that Provide Accessibility

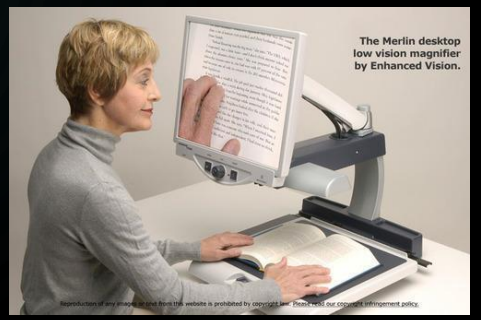
Building Access

- Door Opener
- Ramps
- Workspaces
- Signage
- ATMs

Computer Accessibility

As the computer age continues, more and more technology is being created to make computers and the internet accessible for people of all ability levels.

For **visually impaired users**, programs offer audio description or screen reading, while monitor settings can be modified to make visual reading easier or Braille displays can be used as alternative output devices.

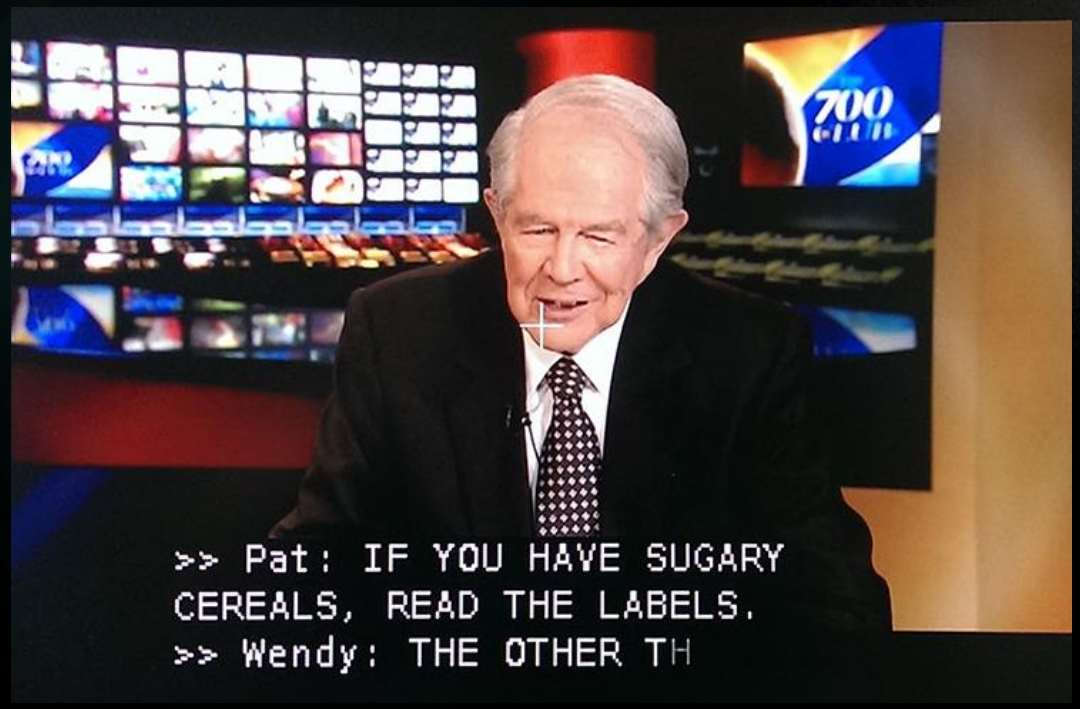


Accessible Technology in the 21st Century

- Introduction

Computer Accessibility

For **individuals with hearing difficulties**, captioning and visual notifications instead of sound can offer more freedom in using a computer.



Accessible Technology in the 21st Century

- Introduction

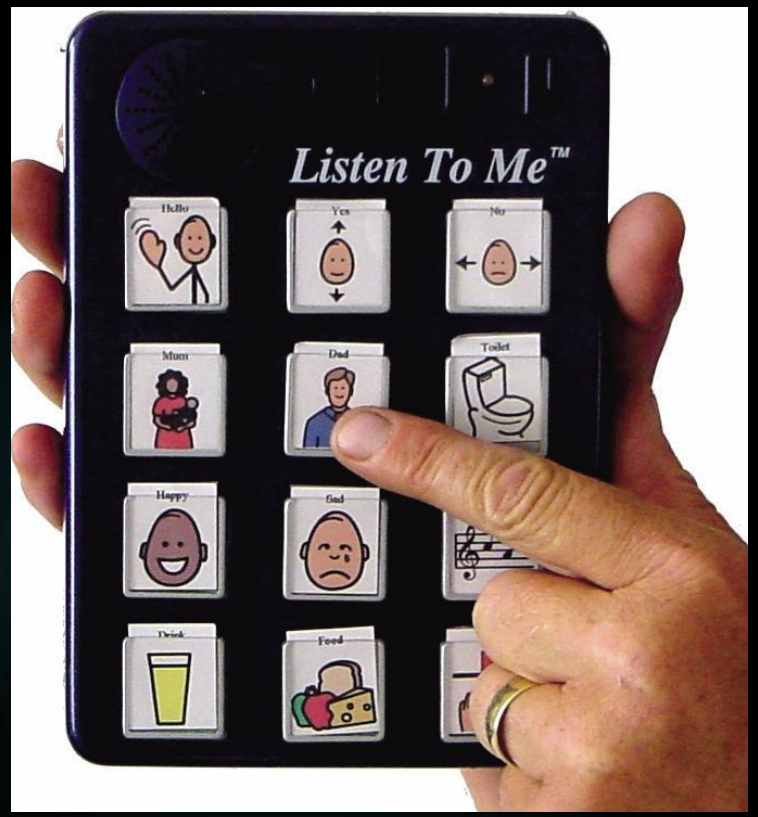
Computer Accessibility

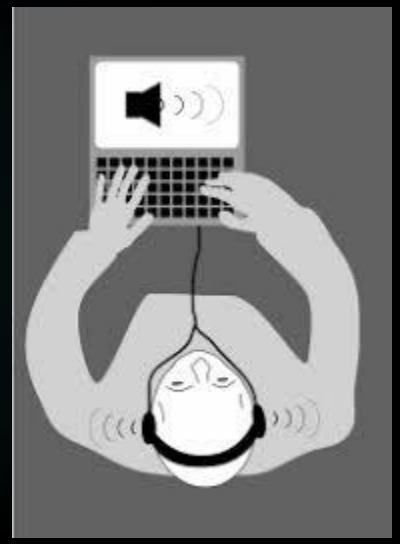
Adaptive keyboards and mice allow **people with motor disabilities** to get their input into a computer, while speech recognition is software that allows control of a computer by voice.

Accessible Technology in the 21st Century

- Introduction

Communication Accessibility





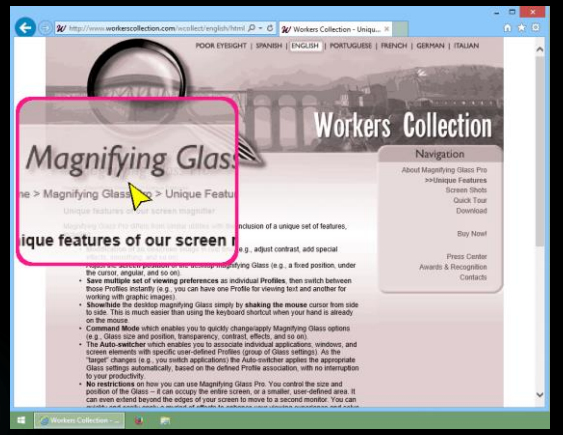
Accessible Technology in the 21st Century

- Introduction

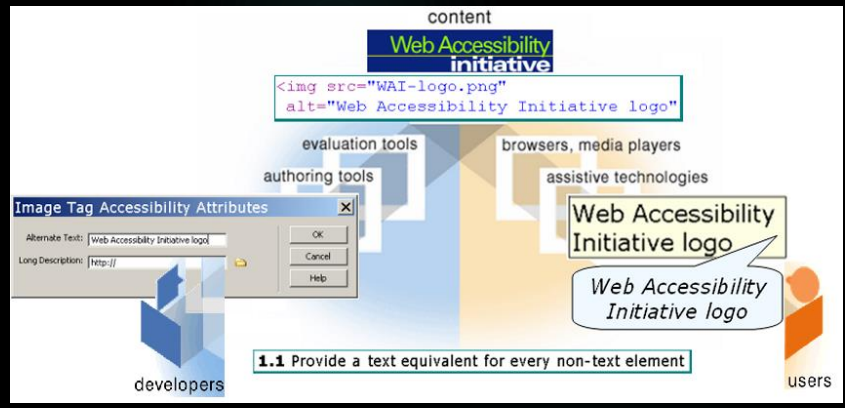
Examples of Devices that Provide Accessibility

Computer Access

- Alternative Mouse
- Alternative Keyboard
- Screen Readers
- Voice Recognition
- Screen Magnifiers
- Braille Displays
- Captioned videos



Accessible Webpages



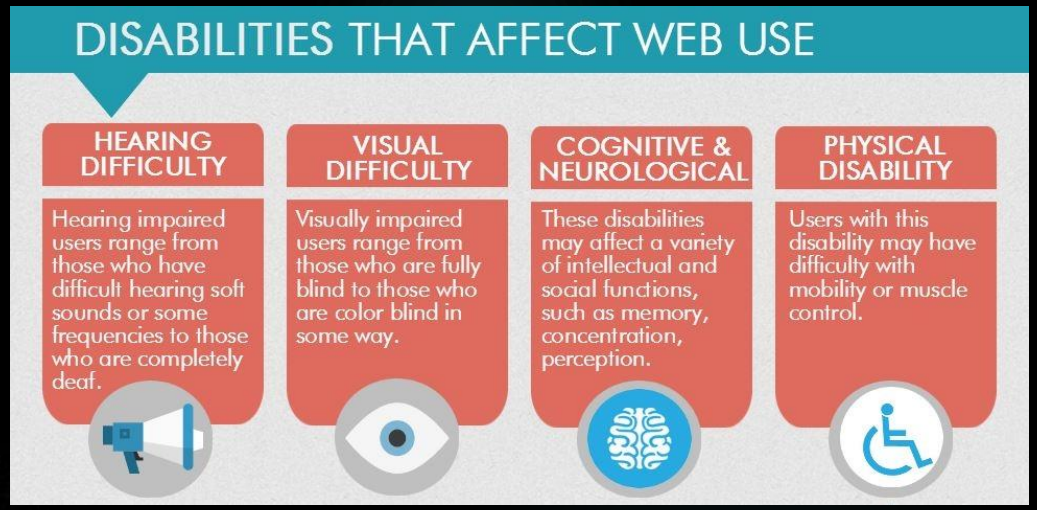
WCAG Guidelines (1 of 2)

- Provide equivalent alternatives to auditory and visual content
- Don't rely on color alone
- Use markup and style sheets and do so properly
- Clarify natural language usage
- Create tables that transform gracefully
- Ensure that pages featuring new technologies transform gracefully
- Ensure user control of time-sensitive content changes

Accessible Technology in the 21st Century

- Website Accessibility

Accessible Webpages



WCAG Guidelines (2 of 2)

- Ensure direct accessibility of embedded user interfaces
- Design for device-independence
- Use interim solutions
- Use W3C technologies and guidelines
- Provide context and orientation information
- Provide clear navigation mechanisms
- Ensure that documents are clear and simple

In Summary

Accessibility is the design goal, feature, or criteria that allows people of differing abilities to share common resources.

In Summary

Examples of shared common resources are:

- buildings
- transportation systems
- consumer products including computers and software
- institutions such as schools, banks, government facilities, libraries, voting places
- facilities such as parks, playgrounds, beaches
- information systems such as books and the internet

In Summary

In many instances, the use of an assistive technology device can provide needed access to an otherwise inaccessible resource.

Thursday, February 1st

The Third Arm Project

J. Kenneth Salisbury, Jr., PhD

Stanford Professor of Computer Science (Emeritus)

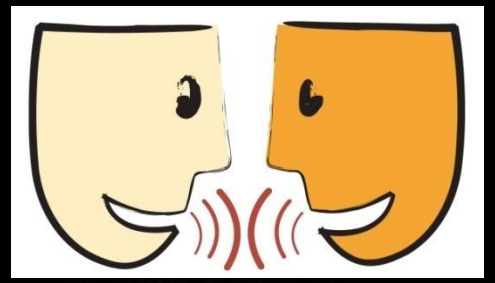
Today

Brain-Computer Interfaces

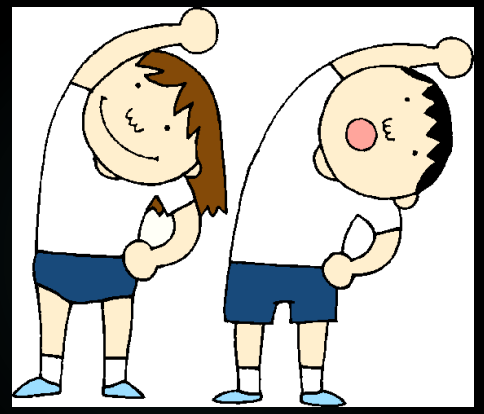
Erin M. Kunz, PhD Candidate

Stanford University - Neural Prosthetics Translational Laboratory

Break Activities



- Breakout rooms
- Attendance sheet
- Stand up and stretch
- Take a bio-break
- Text message
- Web-surf
- Respond to email
- Talk with classmates
- Reflect on what was presented in class



Short Break