



SFWRENG 4HC3 6HC3 /COMPSCI 4HC3

Human Computer Interfaces

17 – Universal Design

SFWRENG 4HC3 6HC3 | COMPSCI
4HC3

Danny Papagiannis

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User Participation

- In general evaluation techniques that involve users can occur in the **laboratory** or in the **field**
- Both laboratory and field studies can be **costly**
 - Field studies involve interruption to work day and onsite evaluation
 - Laboratory studies also interrupt participants work day and require them to travel to the lab
- There are benefits and drawbacks to both which we will now discuss

Validity

- External validity
 - confidence that results applies to real situations
 - usually good in natural settings
- Internal validity
 - confidence in our explanation of experimental results
 - usually good in experimental settings
- Trade-off: Natural vs Experimental
 - precision and direct control over experimental design versus
 - desire for maximum generalizability in real life situations

Learning Objectives

- By the end of the lesson, you will be able to:
 - Define ‘universal usability’
 - Address the needs of diverse populations through interface design

Special Topics in HCI

UNIVERSAL DESIGN

Usability, Usefulness ...

Usability, Usefulness and Accessibility

“It is estimated that at least 10% of the population of every country has a disability that will affect interaction with computers.”

-Dix, Finlay, Abowd, Beale

Accessibility

- Newell (1995) points out that the sort of issues that face an ordinary person in an extraordinary environment (such as under stress, time pressures, etc.) are often similar to the issues that face a person with disabilities in an ordinary environment.

Accessibility

- Access to physical spaces for people with disabilities has long been an important legal and ethical requirement and this is now becoming increasingly so for information spaces.
- Legislation such as the UK's Disability Discrimination Act and Section 508 in the US now requires software to be accessible.
- The United Nations and the World Wide Web Consortium (W3C) have declarations and guidelines on ensuring that everyone can get access to information that is delivered through software technologies

Economic and Cultural Exclusions

- **Economic:**
 - people are excluded if they cannot afford some essential technology.
- **Cultural:**
 - designers make inappropriate assumptions about how people work and organize their lives. For example, using a metaphor based on American football would exclude those who do not understand the game.

Social Exclusion

- **Social exclusion** can occur if equipment is unavailable at an appropriate time and place or if people are not members of a particular social group and cannot understand particular social mores or messages.

Physical Exclusion

- Inappropriate positioning of equipment
- Input and output devices making excessive demands on user abilities.
- Examples: an ATM may be positioned too high for a person in a wheelchair to reach, a mouse may be too big for a child's hand or a mobile phone may be too fiddly for someone with arthritis to use.

Conceptual Exclusions

- People may be excluded because they cannot understand complicated instructions or obscure commands or they cannot form a clear mental model of the system.

Curb Cuts: Universal Design

- Curb cuts help people with mobility devices (such as wheelchairs).
- Tactile additions help people with low vision.
- ... these also help everyone: people with suitcases, baby strollers, texting and not watching where they are going, wearing roller blades, etc.



http://www.armor-tile.com/articles_docs3/ADA-Compliant-Curb-cuts-Safety.html



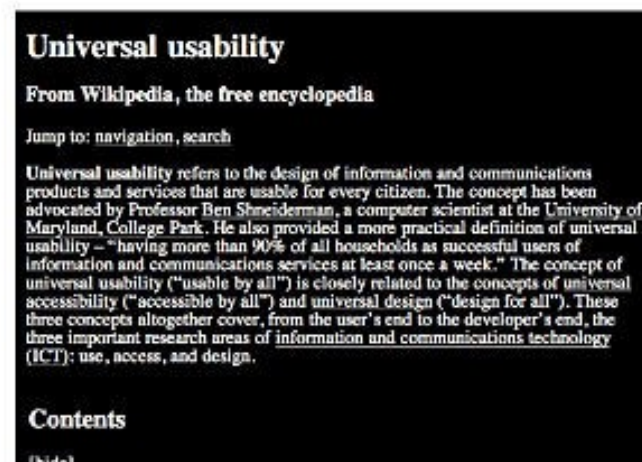
Wikipedia

Universal Design in Interfaces

Flexibility and user control allow users to adapt designs to meet their needs and preferences



Standard



High-contrast text



Enlarged text



Without styling

Principles of Universal Design

- **Equitable Use:** The design does not disadvantage or stigmatize any group of users.
- **Flexibility in Use:** The design accommodates a wide range of individual preferences and abilities.
- **Simple, Intuitive Use:** Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.
- **Perceptible Information:** The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.



Memorize!

Principles of Universal Design

- **Tolerance for Error:** The design minimizes hazards and the adverse consequences of accidental or unintended actions.
- **Low Physical Effort:** The design can be used efficiently and comfortably, and with a minimum of fatigue.
- **Size and Space for Approach and Use:** Appropriate size and space is provided for approach, reach, manipulation, and use, regardless of the user's body size, posture, or mobility.



Memorize!

Accessibility in User-Centered Design

- A great online book and resource:

<http://www.uiaccess.com/>

Just Ask: Integrating Accessibility Throughout Design

Welcome

Cover

About the Book

Table of Contents

Introduction

The Basics

Incorporating

Involving

Interacting

Accessibility in ucd

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Welcome to *Just Ask*, a different kind of accessibility book

Just Ask: Integrating Accessibility Throughout Design helps designers, developers, and managers create websites, software, hardware, and consumer products that

- are accessible to people with disabilities and older users,
- provide a better user experience for all users, and
- help organizations maximize the benefits of accessibility.

Please read the [Introduction](#), which sets the stage for the book and gives examples of why it's so important to make your products accessible.

- ***Just Ask* is available free online in [English](#), [Spanish \(Español\)](#), and [Japanese \(日本語\)](#) thanks to [sponsors and supporters](#).** If your organization might be interested in sponsoring *Just Ask*, see [Sponsorship Opportunities](#).
- The [print book](#) is available in English from Amazon, and [for much less from here](#). The print book is also available in Spanish from [Imprimir libro](#).
- Browse the [cover](#) page online for a brief overview, along with review comments under "[what people are saying about the book](#)".
- Help spread the word about *Just Ask* (see [Be a Just Ask Supporter](#)) and its promotion of including people with disabilities in the design process to make

SUPPORTING EVERYONE: EXAMPLES

Visual Impairment

- A visual impairment can limit ones ability to view text and graphical output
- With text output, a common solution is to use a **screen reader**
- What about with graphical output?

Visual Impairment

- With graphical output a user interface designer may be able to do any of the following:
 - Provide **alternative text for graphics** so that a screen reader can be used (**Example:** webpages)
 - Use **sound** to provide auditory cues regarding the graphical elements in the interface (**Example:** mouse-over sounds for buttons)
 - Use **tactile output** to provide more information about graphics (**Example:** braille)

Alternative Text



"This image is a line art drawing of a grey magnifying glass with blue glass. If you click on it, it will take you to the Search page for this Acme Company website."

Alternative Text



“Search”

- Avoid overly descriptive text!

VoiceOver

- A built in screen reader with Mac OS X
- Supports speech synthesis as well as braille display output
- Website:
<http://www.apple.com/accessibility/voiceover/devicesupport.html>

Narrator


- A built in screen reader with Windows 7
- Supports speech synthesis
- Website:

<http://windows.microsoft.com/en-US/Windows7/Hear-text-read-aloud-with-Narrator>

Hear text read aloud with Narrator

Windows comes with a basic screen reader called Narrator, which reads text on the screen aloud and describes some events (such as an error message appearing) that happen while you're using the computer.

Narrator is not available in all languages, so if the steps below don't work, Narrator is not available for your language.

1. To open Narrator click the **Start** button , and then, in the search box, type **Narrator**. In the list of results, click **Narrator**.
2. Use the keyboard shortcuts in the following table to specify which text you want Narrator to read:

Use this keyboard shortcut	To do this
Ctrl+Shift+Enter	Get information about the current item
Ctrl+Shift+Spacebar	Read the entire selected window
Ctrl+Alt+Spacebar	Read the items that are selected in the current window

<Demo>

Hearing & Speech Impairment

Output

- Multimedia is one area where a hearing impairment can be difficult
 - (As with television content) it is important the multimedia content on the web have **captions**

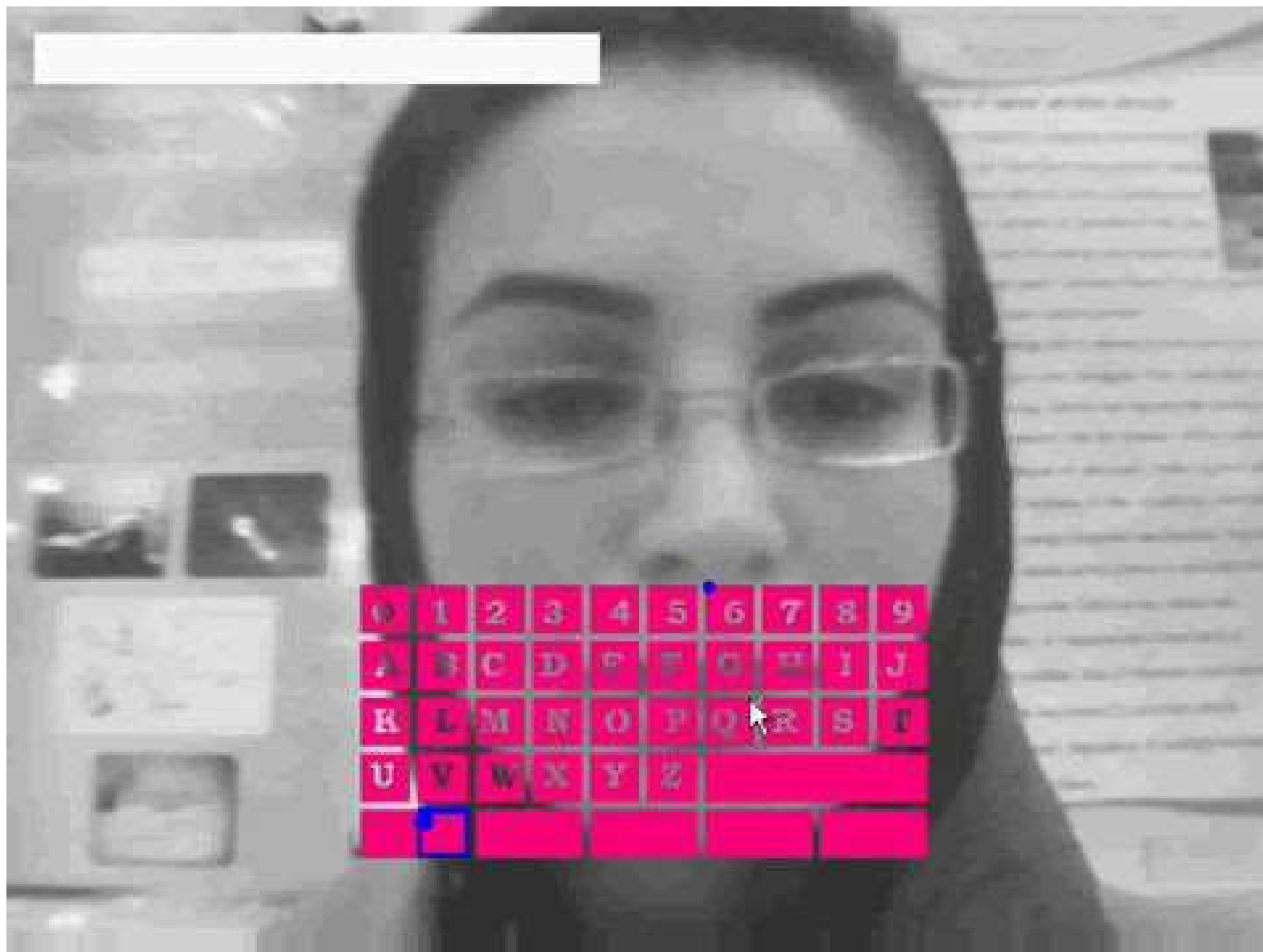
Input

- In addition to traditional text-based input the use of **gesture-based** input could enable users to use sign language with a computer
 - This may be faster depending on the gesture recognition software

Physical Impairment

Input

- With a physical impairment, providing input using a keyboard and mouse may be limited or not possible
- Alternative forms of input maybe used including:
 - Speech
 - Eyegaze
 - Keyboard with predictive text



<https://www.youtube.com/watch?v=ofBVINGFANA>

Dyslexia

- *“...a learning disability that manifests primarily as a difficulty with written language, particularly with reading and spelling.”*
- Wikipedia
- Speech input and output can be used in place of text
- Special spell checkers can be used
 - Example: <http://www.ghotit.com>
- When conducting design navigation recall the design principle – “Be Consistent!”
 - Use color-coding and visual queues to help users navigate the interface

Captchas

ZKW4

[Megaupload]

BMVHKY

[Reddit]

94451

[eBay]

Zd6bf

[CNN]

RAE3

[Baidu]

3-2 parks

[Recaptcha]

adv ses

[Captcha.net]

3nc9z

[Authorize]

quxg4h

[Skyrock]

2CCEX

[NIH]

2 p 1 c p

[Digg]

skynetgomi

[Google]

trustother

[Wikipedia]

ap88cot

[Slashdot]

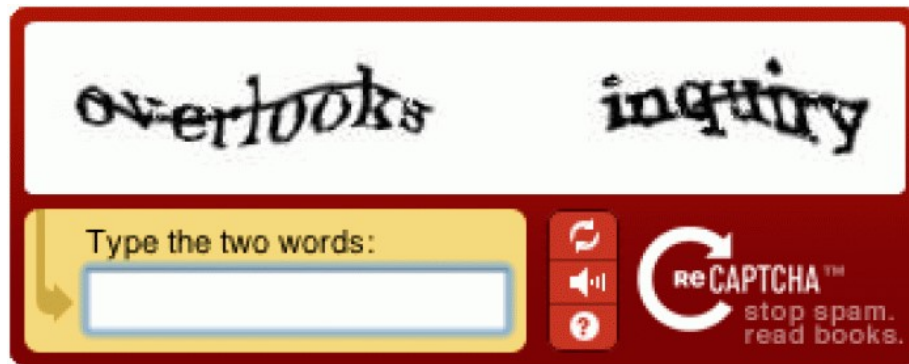
p m y m k u

[Blizzard]

<http://www.extremetech.com/wp-content/uploads/2011/11/captcha-selection1.jpg>

W3C Accessible Captchas Guidelines

- Solutions:
 - Logic puzzles, audio outputs
 - Single sign on across sites
 - Better spam filtering and heuristic detection of robot users
- <http://www.w3.org/WAI/intro/captcha.php>



Example reCAPTCHA with audio alternative

Please answer this question:

What do humans use to chew their food?

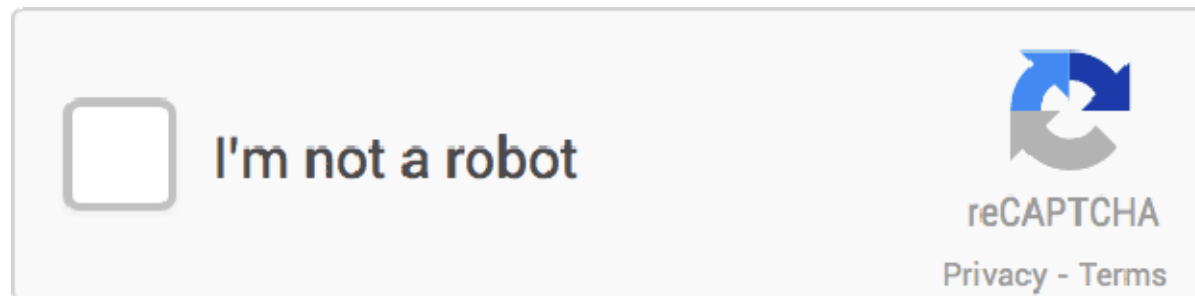
<input type="checkbox"/> Necklace	<input type="checkbox"/> Lock
<input type="checkbox"/> Teeth	<input type="checkbox"/> Hammer
<input type="checkbox"/> Money	

Example logic captcha

<http://files.samhart.net/img/misc/logic-captcha.png>

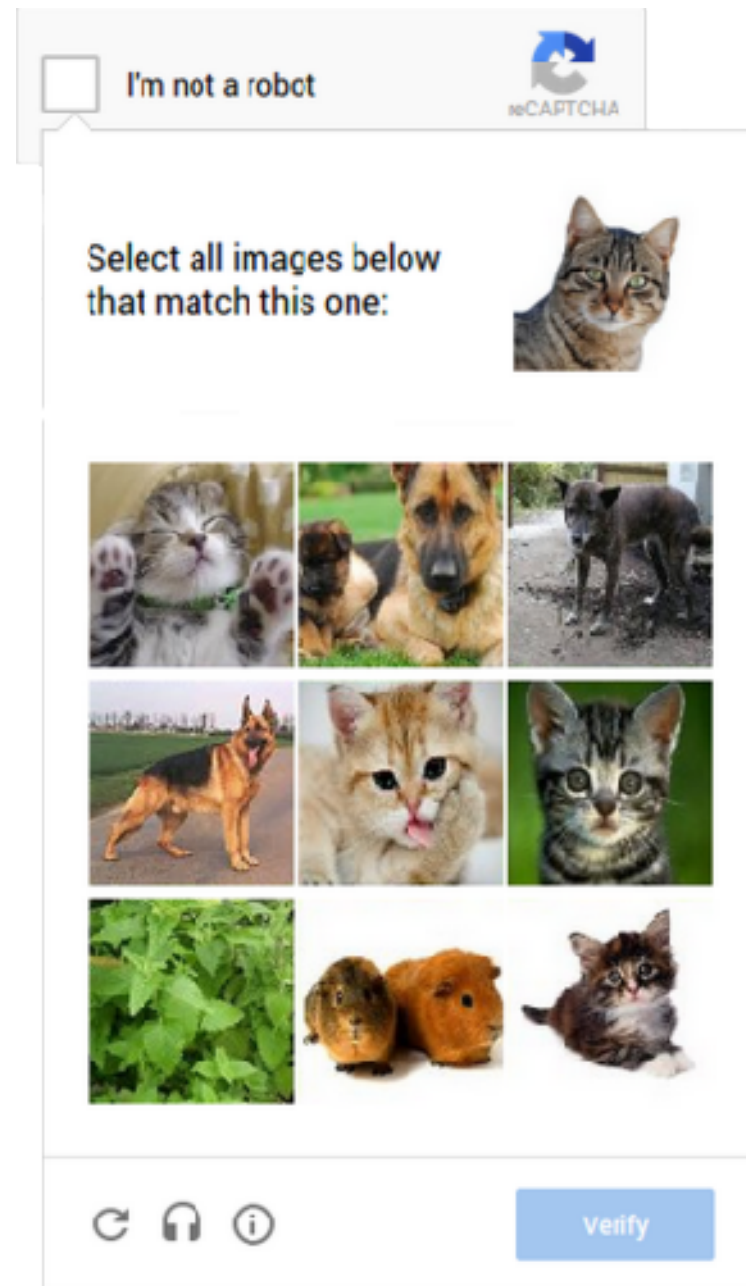
Single Click Captcha

- The way someone moves a mouse in the moments before a single click can be enough to detect a bot.



<http://www.wired.com/2014/12/google-one-click-recaptcha/>

Mobile Version



Autism

- *“...affects a person’s ability to communicate and interact with people around them and to make sense of their environment.”*

-Dix, Finlay, Abowd, Beale

- Computers can be used to help people with autism communicate
 - The use of **graphics** and **speech synthesis** can help
- Computers using **virtual reality** can help educate people with autism practice appropriate forms of interaction

Autism Apps



What does it do	On what device	For what ages	Or search by keyword	
<div> <div><Any></div> <div> <div><Any></div> <div>Recreation</div> <div>Social Skills</div> <div>Accessibility</div> <div>Behavioral Intervention</div> <div>Communication</div> <div>Creative Arts</div> <div>Educational</div> <div>Functional Skills</div> <div>Language</div> <div>Math Skills</div> <div>Organizer</div> </div> </div>	<Any>	<Any>	<input type="text"/> <input type="button" value="Apply"/>	
	Category	Platform	Age	Supporting Research
	• Behavioral Intervention	• Android	• All Ages	No Data
	• Recreation	• iPad	No Data	Research
	• Behavioral Intervention	• iPhone		Show more
		• iTouch		
	• Language	• iPad	No Data	Research
		• iPhone		Show more
		• iTouch		
ABA Teamwork LS	• Behavioral Intervention • Organizer	• Windows 8	• All Ages	Anecdotal
ABA Therapy Images	• Behavioral Intervention	• iPad • iPhone	No Data	Anecdotal
ABA Timer	• Behavioral Intervention	• iPad	• Preschool (2-5) • Children (6-12)	No Data

<https://www.autismspeaks.org/autism-apps>

ACCESSIBILITY STANDARDS

W3C Web Accessibility Initiative

- Guidelines and technical specifications for universal web design, for example:
 - Supporting screen reading
 - Use of styles which can be customized by accessibility plugins
 - Evaluation tools
- <http://www.w3.org/WAI/>
- Web Content Accessibility Guidelines adopted as ISO 40500:2012 standard



Do you have trouble
typing, moving a
mouse or reading
a screen?



[Download Now](#)

“A virtual wheelchair for your website”
The New York Times

PROUD SUPPORTERS



For Socially Responsible Organizations

What are you doing to reach out to seniors and people living with disabilities? Integrate a disability platform into your online activities and deliver a transformational experience with universal appeal.

Join our Disability Community Involvement Initiative and make it a key pillar of your Diversity and CSR strategies today.

[Request A Meeting](#)

Advocacy Partners

eSSENTIAL Accessibility™ is
championed by leading advocacy groups



Essential Accessibility: Who?

- People with physical disabilities that prevent them from using a traditional mouse and/or keyboard to browse the web.
- For example, individuals with conditions arising from:
 - Stroke
 - Paralysis
 - Arthritis
 - Dyslexia
 - Multiple sclerosis
 - Cerebral palsy
 - Parkinson's
 - Age-related factors

Essential Accessibility App:

What does it do?

- **Hands-free tracking:** You can control your mouse by moving your head or your hand in full view of your computer's front-facing camera, commonly referred to as a webcam.
- **Onscreen keyboard:** Instead of using a physical keyboard to enter text in a web page, you might prefer to use your mouse instead. The on-screen keyboard offers convenience keys labeled "www." and ".com" that you can use to reduce the number of mouse clicks you need to make.
- **Page reader:** You can have the app read aloud the text on a web page. It can read aloud any text, button captions, website texts, links, tags, and other elements that contain text that isn't embedded in graphics.
- **Manual scan**
- **Auto scan**
- **XY mouse:** Every point on a web page sits at a certain latitude and longitude, much like a point on a map. The app can navigate to each spot on a map by first moving to the correct latitude and then the correct longitude.
- **Direction mouse:** Using the directional mouse, you can move the mouse in one of eight directions and click it, all using only the left click button on your mouse.
- **Radar mouse:** This mouse alternative "sweeps" the eSSENTIAL Accessibility™ window much like the line on an airport radar screen. Airport radar displays typically "anchor" their lines in the center of the screen. The app's radar mouse offers that option, as well as that of anchoring the line at the top left corner of the screen.
- **Customizable toolbar**
- **Multi-language**



Best Buy gives back to the community's where we do business in many ways. Now we are pleased to announce a new way of reaching more Canadians. Through our alliance with **eSSENTIAL Accessibility™**, Best Buy is taking part in a **Disability Community Involvement Initiative** launched in association with leading advocacy groups for the disabled.

If you have trouble typing, moving a mouse or reading, eSSENTIAL Accessibility can greatly enhance your experience at bestbuy.ca.



[Click here](#) to download keyboard and mouse replacement solutions free of charge.

Keyboard and mouse replacement solutions include a webcam-based hands-free movement tracking system, a page reader, predictive typing and other customizable options.

eSSENTIAL Accessibility tools can be used on a standard PC* by anyone with dexterity challenges or reading difficulties arising from a variety of conditions, including:

PicturePlanner

COGNITIVE SUPPORT EXAMPLE

PicturePlanner

- An icon-based tool for individuals with cognitive disabilities and their caregivers
- The purpose of the tool is to allow users to schedule activities for the day, week, etc.
- Website: <http://cognitopia.com>

PicturePlanner

Activity Builder

Create An Activity

6:00 PM Wednesday, October 1

WHAT?	WHO?	WHERE?	HOW?	COST?	BRING?	CLOTHES?

remove print when Copy done

Source: <http://cognitopia.com>

PicturePlanner

- The design of picture planner has the following goals:
 - “...enable maximally independent use of individuals with limited reading ability...”
 - “...enable use by those for whom standard commercial software interfaces are overly complex and non-intuitive.”
 - “...have the application incorporate a metacognitive approach to interface design that seeks to anticipate the information management challenges experience by individuals with cognitive disabilities.” [Kea06]

PicturePlanner

- Goal 1: “...enable maximally independent use of individuals with limited reading ability...”
- How?
 - Elements in the interface are tri-modal icons
 - Text
 - Picture
 - Text to speech synthesis

PicturePlanner

- Goal 2: *“...enable use by those for whom standard commercial software interfaces are overly complex and non-intuitive.”*
- How?
 - Use single click instead of double click
 - Simplify screen layout
 - For user tasks, avoid multi-screen action sequences
 - Use “out and back” action sequences which ensure the user returns the original screen

PicturePlanner

- Goal 3: *“...have the application incorporate a metacognitive approach to interface design that seeks to anticipate the information management challenges experience by individuals with cognitive disabilities.”*
- How?
 - Explicit representation of metacognitive data
 - **Example:** going to a movie
 - Need to store metacognitive data such as transportation route, travel time, location, cost, other people attending, etc.

TAG Lab

- “Technology for Aging Gracefully” Lab
- <http://taglab.utoronto.ca/>
- Cognitive, physical support for seniors
- Bereavement technologies

MyVoice - Context Aware Communication Aid

Phones are getting smarter. Many now have sensors that can detect things like location (in other words, these phones know where they are). In a first project, Friend Forecaster, we leveraged this sensing technology to create a context-aware cell phone that could make plausible conjectures of individuals one might encounter in a given situation, thereby aiding the many senior citizens who experience difficulties in recalling people's names. Currently, we are working on MyVoice, a context-aware application that suggests vocabulary — words, phrases, and sentences — based on the locations the user visits. MyVoice seems particularly useful for individuals with anomic aphasia, which often results from strokes, certain types of dementia, and other types of brain injury.

People

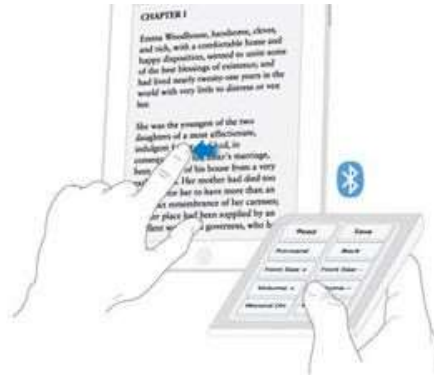
[Alex Levy](#)
[Mike Massimi](#)
[Golnoosh Pourshahid](#)
[Aakash Sahney](#)
[Kevin Tonon](#)

Sponsors

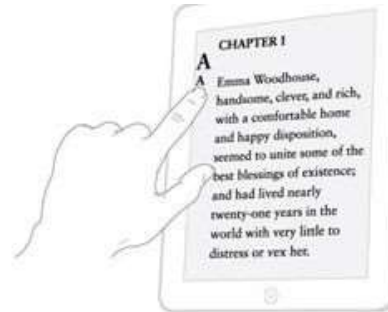
[Google](#)
[NSERC](#)



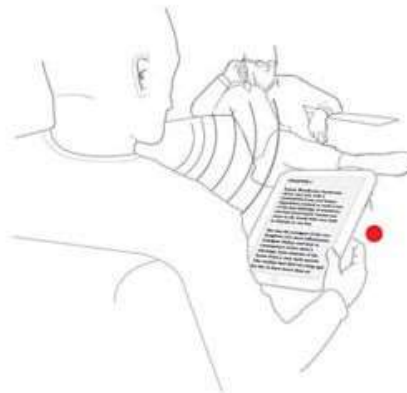
Large Print Listening and Talking eBooks



The ALLT e-book is Accessible to people with different sensory and motor abilities.



It provides a Large-print capability by magnifying the type.



It *Listens*, i.e., it records the voice of a family member reading to the user to allow that voice to be later heard in (re)reading.



It also *Talks*, i.e., it speaks the text aloud as in books on tape, using either a computerized voice or the voice of a family member.

Digital Life Histories / SenseCam

SenseCam Re-experience

Unfiltered SenseCam image stream



Average number of images captured in a 3 hour outing ~500

Initial display rate: 2 frames per second (participant could adjust)



SenseCam Remix

Caregiver selected images with narration



Image Processing



Select ~24 images
Record narration (variable)



Narrated slideshow



Mobile Device Accessibility

- Mobile devices like smartphones should be available to everyone
- Which aspects may be difficult for people with physical / cognitive disabilities?

Activity

- Try to activate the accessibility features on your phone – can you find them? What do they do?

iOS Mobile Accessibility

- Vision:
 - VoiceOver
 - Zoom
 - Invert Colors
 - Grayscale
 - Speech: Speak Selection, Speak Screen, Speak Auto-text
 - Larger Text
 - Bold Text
 - Button Shapes
 - Increase Contrast
 - Reduce Motion
 - On/Off Labels
- Hearing:
 - Hearing Aids
 - LED Flash for Alerts (iPhone only)
 - Mono Audio
 - Phone Noise Cancellation
- Media:
 - Subtitles & Captioning
 - Video Subscriptions
- Learning:
 - [Guided Access](#)
- Interaction:
 - Switch Control
 - [AssistiveTouch](#)
 - Touch Accomodations (ignore repeat, hold duration)
 - Call Audio Routing
 - Home-click Speed
 - Sticky keys (hardware keyboard)
 - Reachability (iPhone 6 and iPhone 6 Plus only)

Screening Techniques

- Screening techniques are simple activities to help identify potential accessibility barriers in product designs.
 - a software designer turns off her monitor and uses a screen reader to interact with her application;
 - a usability specialist uses a mouthstick or unplugs his mouse to get an idea of how usable a product is by people who cannot use their arms or hands
- Screening techniques are **not disability simulations**.

Screening Techniques



<http://www.uiaccess.com/accessucd/screening.html>

