Interaction Techniques
SWE 632
Fall 2021
Administrivia

• Midterm Exams returned today
• HW4 due today
• HW5 due next week
• More details on 1 or 2 studies for subject pool next week
• Tech Talk grades back today
Class Overview

1. **Overview of Interaction Design**: Thinking about User Actions

2. **Considering Physical Actions**: Designing to Ease Physical Constraints

3. **Mobile Design Considerations**: Designing for Mobile Interaction

4. **Universal Design**: Considering Accessibility
Interaction Design Overview
Identifying Actions
Signifiers

• Goals
  • Show which UI elements can be manipulated
  • Show how they can be manipulated
  • Help users get started
  • Guide data entry
  • Suggest default choices
  • Support error recovery

Is this a button? Or a link?
Hinting

- Indicate which UI elements can be interacted with

- Possible visual indicators
  - **Static hinting** - distinctive look & feel
  - **Dynamic hinting** - rollover highlights
  - **Response hinting** - change visual design with click
  - **Cursor hinting** - change cursor display
Help Users Predict Outcome of Actions

- What does this do?
- Should I click it?
Clarity of Wording (Bad Example)

• Design for clarity & precision
Clarity of Wording

• Choose words carefully
• Speak the user’s language
• Avoid vague, ambiguous terms
• Be as specific as possible
• Clearly represent domain concepts
Likely & Useful Defaults

- Default text, if relevant (e.g., date)
- Default cursor position
- Avoid requirements to retype & re-enter data
Modes

• Vary the effect of a command based on state of system
• Examples
  • caps lock
  • insert / overtype mode
  • vi / emacs command modes
  • keyboard entry used for controlling game and chatting
Challenges with Modes

• Modes create inconsistent mapping
  • E.g., control S sometimes saves, sometimes sends email
  • Especially dangerous for frequent interactions that become highly automatic System 1 actions

• Avoid when possible
• Clearly distinguish if necessary
  • Make clear to user which mode they are in and how to change
Command Interactions

• How can a user invoke a command?

• Common examples
  • Menus
  • Buttons
  • Toolbar
  • Dialog box
  • Keyboard shortcut
  • Gesture
  • Voice commands

• What are some advantages and disadvantages of each approach?
Physical Actions
Avoid Physical Awkwardness

- Switching between input devices takes time
- Avoid forcing user to constantly switch between input devices (e.g., keyboard & mouse)
  - e.g., Effective tab order between fields
- Avoid awkward keyboard combinations
After a user has (1) realized that a region is interactable, (2) decided that it will cause the desired action to be invoked

- How long does it take for a user to move the cursor to click on it?

- What factors might influence this time?
Fitt’s Law

• Time required to move to a target *decreases* with target size & *increases* with distance to the target

• Movements typical consist of
  • one large quick movement to target (*ballistic* movement)
  • fine-adjustment movement (*homing* movements)

• Homing movements generally responsible for most of movement time & errors

• Applies to rapid pointing movements, not slow continuous movements
Design Implications of Fitt’s Law

- **Constraining** movement to one dimension dramatically increases speed of actions
  
  - e.g., scroll bars are 1D
Design implications of Fitt’s law

• Making controls *larger* reduces time to invoke actions
• Locating controls closer to user *cursor* reduces time
  • e.g., context menus
Design Implications of Fitt’s Law

• Positioning button or control along edge of screen acts as barrier to movement, substantially reducing homing time & errors
Mobile Design
Responsive Design

- Mobile devices often have smaller form factor than desktop / laptop OS
- Can design a separate UI
- Or may build a **fluid** UI that rescales for different display sizes
Where's the Cursor?

- No cursor on many mobile devices
- Cannot use dynamic hinting to determine which elements can be interacted with
  - May require more use of static hinting
- Fitt's law still applies
  - Fingers are less sensitive, hard to select small buttons, occlude elements
Alternative Inputs

- Modern mobile devices often have a wide range of sensors which can be used for input
  - Camera
  - Microphone
  - Accelerometer
  - Three-axis gyro
  - GPS
  - Barometer
  - Proximity sensor
  - Ambient light sensor

- Enables new interaction techniques
Augmented Reality

- Overlaying generated content on top of view of the real world
Alternative Inputs + Augmented Reality
Universal Design
Supporting Users with Disabilities

• **Perception** - visual & auditory impairments
  • Blindness or visual impairments
  • Color blindness
  • Deafness & hearing limitations

• **Motion** - muscle control impairments
  • Difficulties with fine muscle control
  • Weakness & fatigue

• **Cognition** - difficulties with mental processes
  • Difficulties remembering
  • Difficulties with conceptualizing, planning, sequencing actions
Blindness and Visual Impairments

• Users use screenreader to listen to screen elements
• Reads all of the text on the page
  • Through practice, learn to listen to text at 400+ words per minute

• Important to have *alt-text*
  • Images should have labels that explain them

• Important to have *hierarchy*
  • Rather than visually skimming page, skims page by listening to section heads to determine which level to navigate to next
Motion Impairments
Universal Design

• How can users with physical disabilities be supported in user interactions?

• Good: assistive design - offering equivalent actions for disabled users that cannot take normal actions

• Better: universal design - designing interactions so broadest set of users across age, ability, status in life can use normal actions
Example - Curb cut

- Initially designed for *accessibility* - support for disabled & wheelchairs
- But potentially benefits *all users* of public spaces - people w/ suitcases, hand carts, roller blades, bikes, …
7 Principles of Universal Design

- **Equitable use**: The design is useful and marketable to people with diverse abilities
- **Flexibility in use**: The design accommodates a wide range of individual preferences and abilities
- **Simple and intuitive**: 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
- **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 user's body size, posture, or mobility
Big Topic - Further Reading

Jeff Bigham’s Course at CMU: http://www.accessibilitycourse.com

Amy Ko’s Book Chapter on Accessibility:
https://faculty.washington.edu/ajko/books/user-interface-software-and-technology/#/accessibility#ref-islam10
10 Minute Break
In-Class Activity
In-Class Activity: Interaction Design Guidelines

• Select a common application task (e.g., navigating list of items, invoking commands on content, entering formed text)

• Build a list of alternatives to the standard interaction techniques for this task (e.g., chatbot, AR)

• Describe pros and cons of each alternative

• Describe how each alternative might be adapted to support mobile and universal design