Interaction Techniques

SWE 632
Fall 2023
Administrivia

• Midterm Exam scores up on Blackboard / Gradescope
• HW4 due today
• HW5 due next week
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

Goals → Action Sequence
Signifiers

Is this a button?  Or a link?

• 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
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
Moving the Mouse

- 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 & wheel chairs
- 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

• In groups of 2 or 3

• 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., chat, AR)

• Describe pros and cons of each alternative

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

• Due by 6:25pm today