Assembly and Cutaway Illustration & Interaction

Erik Johansson, Cut & Fold
http://erikjohanssonphoto.com/work/cut-fold/

http://gfycat.com/ScrawnyThoughtfulFairyfly
Today’s Class

- “Designing Effective Step-by-step Assembly Instructions” Agrawala et al., SIGGRAPH 2003
- “Interactive Cutaway Illustrations of Complex 3D Models”
- What is Interaction?
  - Camera Manipulation
  - Data Manipulation
- Interaction Devices
- Picking & 3D Painting
- Visual Response to Interaction
- Readings for Friday
“Designing Effective Step-by-step Assembly Instructions”
Agrawala et al., SIGGRAPH 2003

- Inspired by robotics planning research
- Need to solve planning & presentation simultaneously for best result

Design Principles for Illustrations

- hierarchy/grouping of parts
- hierarchy of operations
- step by step instructions vs. single diagram
- only 1 significant piece at a time
- structural vs. action diagrams
- present as much information as possible
  - don't repeat, don't be tedious
- orientation, natural & preferred views
  - maximize # of important features visible
  - minimize accidental alignments
- visibility
  - occlusion ok when symmetry is clear
  - earlier parts visible for context
Input/Output/Automated/User-Driven

• Input:
  – geometry, orientation, grouping, ordering constraints
• Automatic:
  – location translational blocking, visibility
  – at each step, “planner” chooses to attach a part or reorient diagram
  – optimization for visibility
  – direction (maximally separate, interference free) & separation distance
  – diagrammatic elements, guidelines (based on bounding box or contact)
• Semi-automated user-driven/interactive editing
  – add grouping
  – add constraints
• Not automatic (yet):
  – structure
  – zoom in/use insets to show small details, e.g., subassemblies

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What is Interaction?

- Manipulating objects in a scene
  - Moving
  - Rotating
  - Selecting
  - Deleting
- Manipulating your view of the scene (manipulating the camera)
  - Pan
  - Tilt
  - Zoom

Manipulating the Camera

Berkeley Soda Hall walkthrough
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Interaction Devices

• Keyboard
  – Press a key
  – Hold a key
• Mouse
  – Left button
  – Middle button
  – Right button
  – Single click
  – Double click
• Joystick
  – vibration
• 3D mouse
  (3D Connexions Space Navigator)
• Pen (Wacom) or Touch
• Multi-Touch
• Haptics
  – 3D position
  – 3D direction
  – Directional force feedback
More Interaction Devices

- Wii
- Application-specific input devices (musical instruments, steering wheel, light gun, etc.)
- Microphone (voice control, translation)
- Brain computer interface, stress sensor, muscle sensors
- General video input, tracking (kinect)

Choosing the Right Device

- 2D vs. 3D
- (Haptic) Feedback
- Similar to natural (non digital/virtual) interface
- Availability/expense/learning curve/practicality (space/sound/etc.),
- Resolution/accuracy
- Robustness/noise
  - If requires reset/recalibration, acceptable?
  - Frames per second requirements of haptics
- Comfort/exercise/overuse injuries
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What is “Picking”? 

- Get the (3D) world coordinates of a (2D) mouse click
- Identify which object was selected and the point on the object closest to the click
- How?
“Picking” by Ray Tracing

• Construct a ray from the eye through the image plane into the scene
• Intersect with all objects in the scene
• Keep the closest

• Concerns:
  – Expense of intersection?
  – Positional imprecision/noise?

“Picking” by the Framebuffer

• Color each object a different, unique color (no lighting)
• Grab the color of the pixel from the framebuffer (object id)
• Grab the z-value (depth) from the depth buffer

White, Crane, & Forsyth, “Capturing and Animating Occluded Cloth” SIGGRAPH 2007
Using 3D Painting

http://www-ui.is.s.u-tokyo.ac.jp/~takeo/gallery/chameleon.png

Painting by Picking a Picket Fence?
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Visual Response to Interaction

• Hide/Unhide elements
  – Increase/Decrease level of detail
  – Change camera/magnification
  – Add text labels
• Highlight element(s)
  – Change color
  – Change transparency
• Motion
  – Showing time simulation
  – User can rearrange for clarity/exploration
Animation Explaining Mechanical Parts

http://imgur.com/gallery/FvCTr

Animation to explain an algorithm

http://tholman.com/bezier-curve-simulation/
Quite interesting for “Just” a Slider

How Birth Year Influences Political Views

http://www.nytimes.com/interactive/2014/07/08/upshot/how-the-year-you-were-born-influences-your-politics.html?partner=rss&emc=rss&_r=2&abt=0002&abg=1
Motion for attention/continuity

A Really Small Slice of Americans Get to Decide Who Will Rule the Senate

Put another way: The number of people who’ll decide this election will likely be smaller than the population of Florida.


https://i.imgur.com/GzsqSHS.jpg
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Readings for Friday (*pick one*)

• "Sizing Up Visualization: Effects of Display Size in Focus+Context, Overview+Detail, and Zooming Interfaces", Jakobsen and Hornbaek, CHI 2011
Readings for Friday *(pick one)*

- "Interactive Visualization on Large and Small Displays: The Interrelation of Display Size, Information Space, and Scale", Jakobsen and Hornbaek, IEEE Visualization 2013

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Fig. 1. Space-scale diagrams illustrating two experimental comparisons of zooming interfaces with display size varied between D and 2D: (a) Constant information space (size 2) is used for both display size conditions (left and middle diagram); scale ratio $S/S'$ varies between display sizes. (b) Variable information space (2I vs. I) is used for the display size conditions (middle and right diagram); scale ratio $S/S'$ is constant across display size conditions.