COMS W4170
Scaling Up and Down 2:
From Wall-Sized to Hand-Held

Steven Feiner
Department of Computer Science
Columbia University
New York, NY 10027

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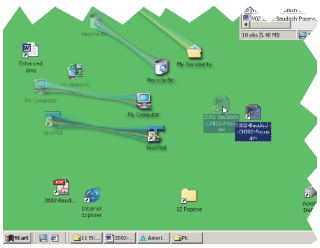
Large Displays: Automated Warping of Drag Targets *P. Baudisch et al., Interact 2003*

- Drag-and-pop
  - User starts to drag object
  - System creates proxies for potential targets in desired directions
    - Connected by "rubber band"
    - Animated closer to dragged object for Fitts's Law "advantage"
  - User selects desired proxy
  - Faster than drag-and-drop when > 1 bezels crossed on multi-monitor wall
  - Issues
    - Warped targets are bunched up
    - Instant warp can be confusing

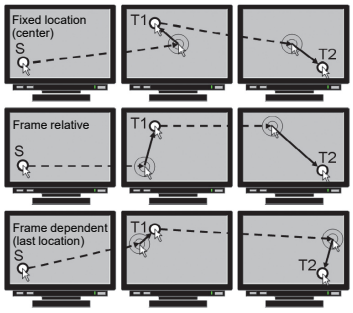
One of many techniques that automatically warp the position/shape/size of the cursor, dragged object, or potential targets



http://www.patrickbaudisch.com/projects/dragandpop/demo/index.html

Large Displays: Manual Warping of Cursor and Drag Objects *H. Benko & S. Feiner, CHI 2005*

- Multi-Monitor Mouse
  - User can warp cursor and object being dragged to a different "frame" using a trigger
  - Pointer placement in new frame
    - Fixed location (e.g., center)
    - Frame relative
    - Frame dependent (e.g., last location)
  - Trigger
    - Mouse or kbd button
    - Head orientation
    - Mouse location
  - Users preferred frame relative, mouse button
  - Faster crossing > 1 bezels on desktop

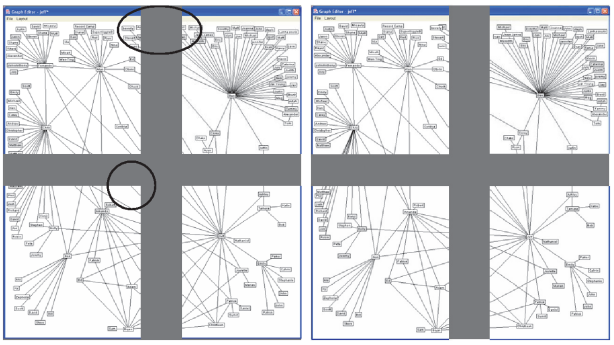


http://www1.cs.columbia.edu/~benko/publications/2005/Benko_MultiMonMouse_CHI05_small.avi

Large Displays: Dealing with Seams

J. Mackinlay & J. Heer, CHI 2004

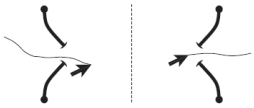
- Seams between displays (e.g., bezels) can cause confusion → Make UI *seam-aware*
  - Take monitor geometry into account when drawing
  - Lay out objects to keep them from being obscured by seams
    - Line up arcs over seams
    - Don't split nodes across seams



Seam-unaware Seam-aware

Stylus UIs: Crossing-Based Interfaces *J. Accot and S. Zhai, CHI 2002*

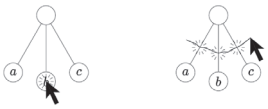
- Replace *pointing at a target* with *crossing a goal*
  - Especially good for selecting thin objects
  - Recall the steering law for a fixed width straight tunnel: $MT = a + b(A/W)$, where W is width of tunnel



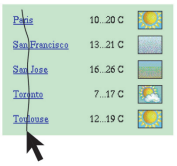
Pointing vs. crossing

Goal can be dynamically oriented toward the cursor (a "sunflower" interface"

Input polymorphism: Pointing and crossing can coexist



Crossing can make it fast to select a sequence of goals



Bidirectional interaction: Crossing can mean a different thing in each direction

Small Displays: Indicating Off-Screen Objects

P. Baudisch & R. Rosenholtz, CHI 2003; S. Gustafson et al., CHI 2008

- Small displays make it difficult to see off-screen objects
  - *Halo*: Surround object with circular "halo" arc just big enough to be visible
    - Halo location & curvature make it easy for user to infer object position
    - Used in Second Life maps
  - *Wedge*: Later work replaces the arc with a wedge whose off-screen tip is at the object
    - Wedges can be automatically rotated to avoid overlap, unlike arcs
      - Helps disambiguate close objects

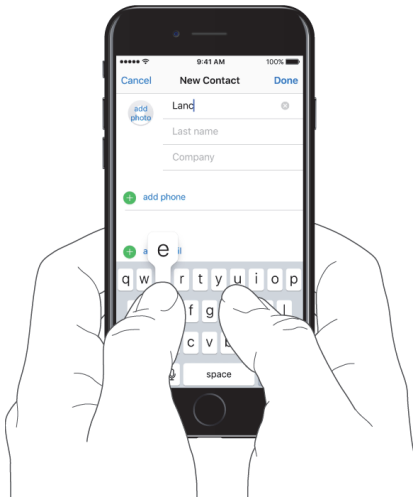
http://www.patrickbaudisch.com/projects/halo/index.html

0:00-1:48

http://www.patrickbaudisch.com/projects/wedge/index.html

Small Devices: Finger Input
Soft Keyboards: Key Presses

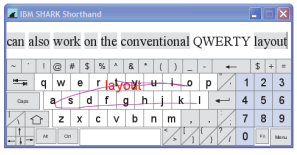
- Apple iPhone
  - QWERTY
  - Multi-touch
  - Entry on key release
  - Confirmation pop-ups to address occlusion
  - Dictionary used to
    - Correct misspellings
    - Correct mistypings by weighting keys based on proximity to touch areas
    - Change sizes of letter target zones based on initial substring



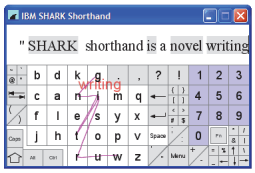
http://help.apple.com/iphone/10/#/iph3c50f96e

Small Devices: Finger Input
Soft Keyboards: Strokes

- SHARK (Shorthand-Aided Rapid Keyboarding, later commercialized as ShapeWriter), Swype
  - *Stroke* between keys, approximating words in dictionary
  - Recognition software resolves ambiguity, including missed keys



SHARK



Swype

SHARK (http://domino.research.ibm.com/library/cyberdig.nsf/papers/8465B3D8A4DD0A9785257222005652BC/$File/rj10393.pdf) [60–80 wpm peak], commercialized as ShapeWriter (was http://www.shapewriter.com), acquired by Nuance (http://www.nuance.com)

Swype (http://www.swype.com), also acquired by Nuance (http://www.nuance.com) ☺

Not *eyes-free*

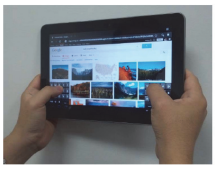
P. Kristensson and S. Zhai, *UIST 2004*

Small Devices: Finger Input
Soft Keyboards: Bimanual Strokes

- Bimanual gesture keyboard
  - Each hand strokes through letters on its half of the keyboard
- How to terminate a word?
  - *Finger-release.* Lifting both fingers off the screen ends the word

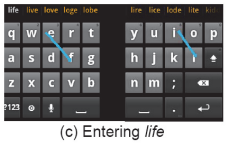
    OR
  - *Space-required.* Space key ends the word
- Users preferred finger-release
- Both approaches theoretically more efficient than unimanual stroke keyboards, *but*
  - Unimanual faster!
  - Bimanual required more mental effort
  - Bimanual more comfortable, less physically demanding

Not *eyes-free*



(a)

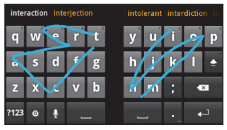
(b)



(c) Entering *life*

(d) Entering *like*

(e) Entering *you*

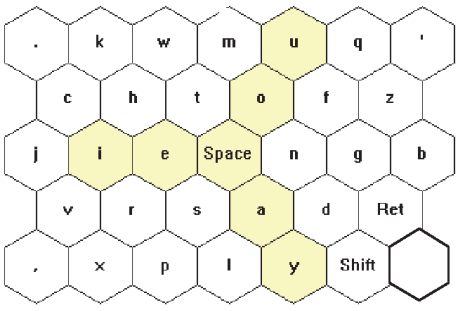


(f) Entering *interaction*

X. Bi et al., *UIST 2012*

Small Devices: Pen Input
New Layouts, Strokes

- QWERTY
  - Conventional
  - ~ 30 wpm
- Metropolis
  - Optimized using Fitts's Law, based on digram pairs, using random walk, simulated annealing
  - ~ 43 wpm

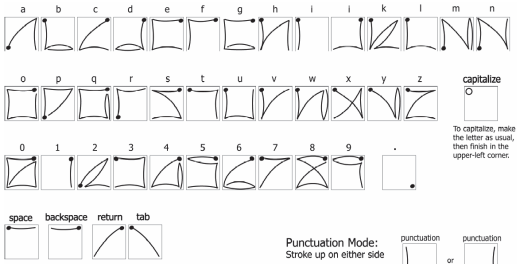


S. Zhai, M. Hunter, & B. Smith, *UIST 2000*

Small Devices: Pen Input Strokes, Bezel Constraints

- Edgewrite
  - *Unistroke:* One stroke per character
  - Enter characters by traversing edges and diagonals of a square hole in plastic template
  - Only sequence of corners traversed matters
  - Square hole enforces (easy-to-make) cardinal-direction gestures

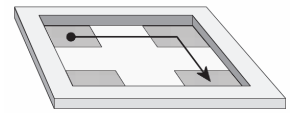
J. Wobbrock, B. Myers, & J. Kembel, *UIST 03*



Eyes-free and *bump-resistant*

- Use of strokes along template border makes it easy for users who are disabled or in motion

Small Devices: Finger Input Menus/Widgets, Bezel Constraints

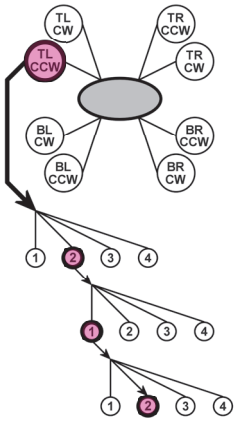


G. Blaskó and S. Feiner, *ISWC 2004*

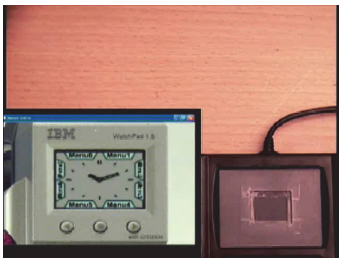
- Corners of watch bezel serve as "tactile landmarks" to guide user's finger

- Cursorless
- Eyes-free

Small Devices: Finger Input Menus/Widgets, Bezel Constraints



G. Blaskó and S. Feiner, *ISWC 2004*



- Cursorless
- Eyes-free

Example: Operating a three-level menu using a single “stroke”