COMS W4170
Interaction Devices 3

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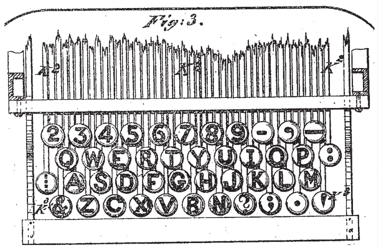
Keyboard: QWERTY

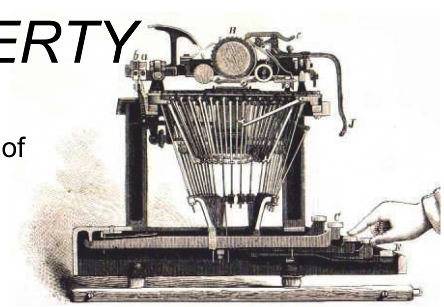
- First used on typewriter by C. Sholes, C. Glidden, and S. Soulé, early 1870s
- Depicted in US Patent 207,559, filed 1875)



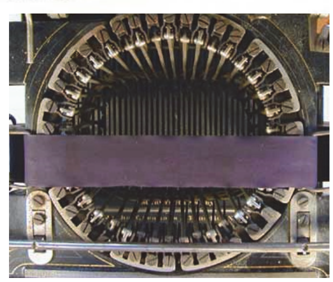
Note: No shift key. This early machine typed capitals only.

Keyboard: QWERTY

- Designed to prevent jamming of keys struck in sequence
- Based on digraph frequency analysis

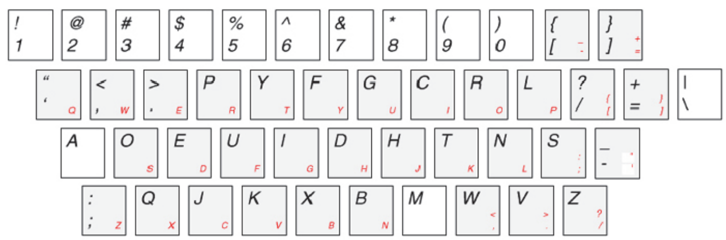


TRANSVERSE SECTION OF THE TYPEWRITER.



Keyboard: DSK (Dvorak Simplified Keyboard)

- Developed by A(ugust) Dvorak, based on time-motion studies, *n*-graph frequency analyses
  - Increase time fingers spend on “home keys”
  - Increase alternation between hands, fingers
- US Patent 2,040,248, filed 1932
- Vehement opinions for/against (e.g., http://www.dvorak-keyboard.com/, http://www.utdallas.edu/~liebowit/keys1.html)
- But, is it faster?



Keyboard: DSK (Dvorak Simplified Keyboard)

- Checkered history of comparison studies with QWERTY
  - 1943 US Navy studies “show” DSK faster
  - 1956 US General Services Admin study (Strong) “shows” QWERTY “brushup” practice more effective
    - Original data destroyed, possible experimenter bias
- Theoretical comparisons suggest 2.3–17% improvement
  - Studies of simulated typing based on digraph speed
- Anecdotal practical comparisons claim improvement
- Try it yourself
  - https://www.howtogeek.com/263849/how-to-switch-to-dvorak-and-other-keyboard-layouts-on-your-computer-or-phone/

Keyboard: Half-QWERTY

- E. Matias, I.S. MacKenzie, and W. Buxton, *INTERCHI 1993*
- Builds on
  - User's knowledge of QWERTY
  - L-R symmetry

Try the demo: http://www.matias.ca/halfkeyboard/demo

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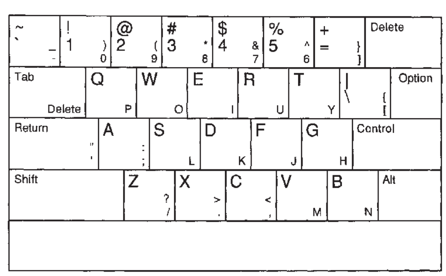
Keyboard: Half-QWERTY

- Keys of one hand remain the same
- Spacebar acts as shift to mirror image keys
- Press–release of spacebar with no other char
  - before timeout is a space
  - after timeout is a no-op
- Modifier keys (e.g., shift, ctrl) work as "sticky keys"
  - Press once to modify next key only
  - Press twice to lock and press again to release



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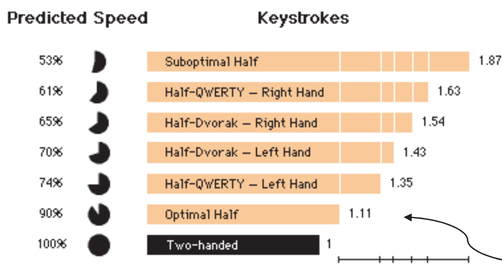
Keyboard: Half-QWERTY

- Naïve speed prediction for a keyboard layout
  - Two hand: Initial cap in sequence of caps = 2 strokes
  - One hand: Initial “flip” in sequence of flips = 2 strokes,
    Each cap = 2 strokes
  - Determine strokes for each keyboard layout typing a sample corpus
  - Speed of KeyboardX relative to two-hand QWERTY
    = (strokes for two-hand QWERTY) / (strokes for KeyboardX)



Graph shows two-hand keyboard strokes normalized to 1

E Matias, IS Mackenzie, and W Buxton, One-handed touch typing on a QWERTY keyboard, *Human-Computer Interaction*, vol. 11, 1996, 1–27.

(This article also has a richer analysis of typing speed and the results of extended testing by a small number of users.)

Keyboard: Half-QWERTY

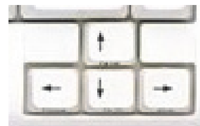
- Study: 10 QWERTY typists, within-subject; at most one 50-min session/day (2-hand pre/post tests, and 1-hand blocks); eyes blocked
- Exceeded hunt-and-peck performance after 3–4 hrs; after 10 hrs, all reached 41–73% of their two-hand speed

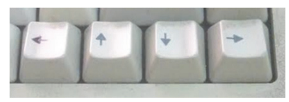
Measure	Hands	Session 1	2	3	4	5	6	7	8	9	10
Speed (wpm)	1	13.2	18.3	21.1	24.4	27.1	29.0	30.7	31.6	33.6	34.7
	2	58.5	59.8	62.3	61.6	63.7	63.3	64.0	64.6	66.2	64.9
Errors (%)	1	15.96	12.13	9.93	9.70	9.21	8.98	7.55	8.23	7.54	7.44
	2	3.25	3.40	2.45	3.05	3.40	3.55	3.55	3.55	3.30	4.20

E Matias, IS Mackenzie, W. Buxton, *INTERCHI 93*

Keyboard: Hardware Device Issues

- Keyboard design
- Keyboard layout
  - CR, BSP, DEL, CTRL, FN
  - Cursor keys
  - Number pad (123 on top vs. bottom)
  - QWERTY, DSK,…
- Key size/shape
  - Flat vs. contoured top
- Key type
  - E.g., membrane
- Scale

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Keyboard: Hardware Device Issues

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www.microsoft.com

www.safetype.com


www.kinesis-ergo.com

en.wikipedia.org/wiki/Datahand

orbitouch.com

www.infogrip.com

twiddler.tekgear.com

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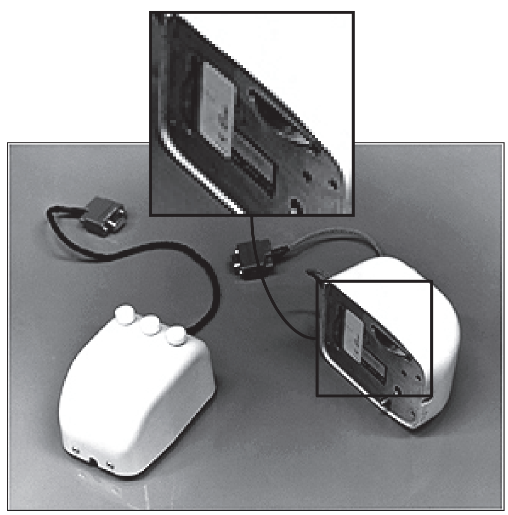
Locator

- Specifies a location
- Can be used to select, position, orient, specify path, quantify, enter text

Locator: Hardware Device Issues

- Grip
  - Stylus vs. mouse
- Time to pick up
- Active vs. passive stylus
- Mouse tracking technology
- Case study: Mouse design
  - Shape
  - Buttons
  - …



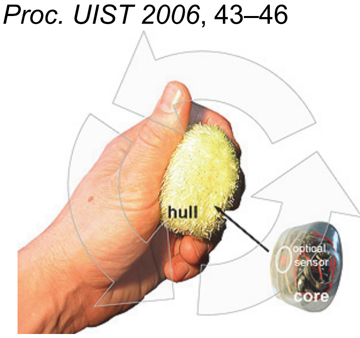
SRI mouse

Case Study: Mouse Design

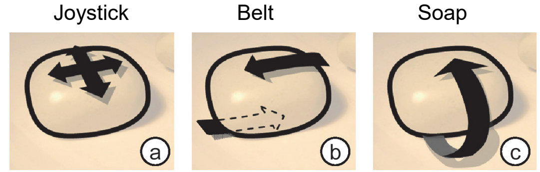
Case Study: Hacking a new device

Soap Baudisch, P., Sinclair, M, and Wilson, A. Soap: A mouse-like pointing device that works in mid-air. *Proc. UIST 2006*, 43–46

- Wireless optical mouse internals repackaged in lozenge-shaped plastic “core” and surrounded by cloth “hull”
- Manipulation approaches
  - “Joystick”
    - Similar to handheld spring-loaded joysticks and “upside-down optical mouse”-like devices
  - “Belt”
    - Drag hull with core stationary
  - “Soap”
    - Filp core with hull stationary



Joystick | Belt | Soap

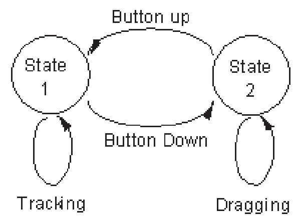


http://www.patrickbaudisch.com/projects/soap/index.html

Three-State Model W. Buxton, A Three-State Model of Graphical Input. *Proc. INTERACT '90,* 449–456

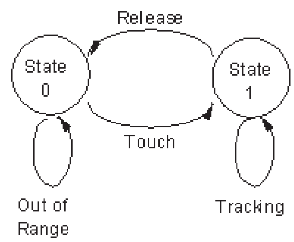
- Mouse
  - Two states: *tracking* (button up), *dragging* (button down)
    - State names are just examples

Note: Actual devices shown in photos may have a superset of the states listed here



Mouse

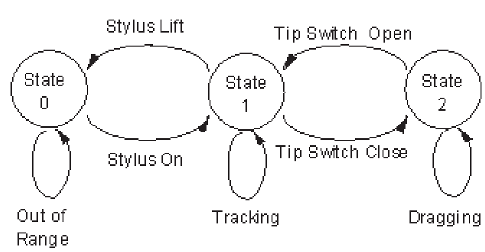
- Touch Tablet/Pad (*separate* from display)
  - Two states: *out of range* (not touching), *tracking* (touching)
    - State 0 is used to designate a state the system cannot sense
    - State 1–State 0 transition = "pen has left the paper"
      - Does this generate an explicit event?



Touch tablet/pad

Three-State Model W. Buxton, A Three-State Model of Graphical Input. *Proc. INTERACT '90,* 449–456

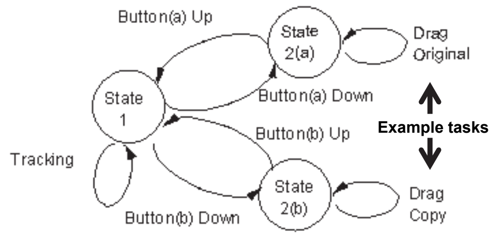
- Stylus with Tip Switch
  - Three states: *out of range* (not touching), *tracking* (touching, with switch open), *dragging* (touching, with switch closed)



Stylus with tip switch

Three-State Model W. Buxton, A Three-State Model of Graphical Input. *Proc. INTERACT '90,* 449–456

- Multi-button Mouse
  - Three states: *tracking* (buttons up), *dragging a* (button *a* down), *dragging b* (button *b* down)
    - Could use double clicking on a one-button mouse to distinguish among states 2a/b
    - Could also have state 2ab (both buttons down)



- Note: State names (*tracking*, *dragging*) are just examples. E.g., state 2 could instead be drawing, interacting with a menu,…
- Note: *Tracking* is sometimes known as *hovering* (esp. when the device doesn't change position for some set amount of time)

Three-State Model W. Buxton, A Three-State Model of Graphical Input. *Proc. INTERACT '90,* 449–456

- How to support selection in 0–1 state device?
  - Use state 1–state 0 transition (liftoff)
  - Use double tap/click
  - Use timeout cue (point at object for time $t \geq t_{select}$)
  - Use pressure threshold (if device can detect >1 level of pressure)
  - Use number of fingers or area of touch (if device can detect)
  - Use other hand on other device (e.g., to push a button)
  - Add a button to device