CS160: User Interface Design

Prototyping 02/22/12

Berkeley
UNIVERSITY OF CALIFORNIA

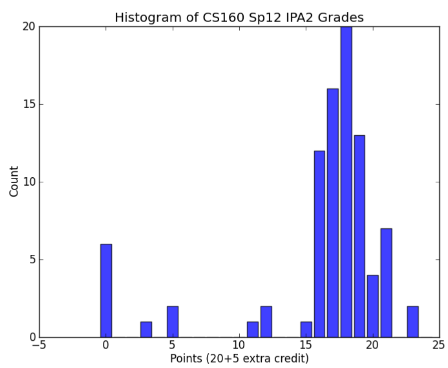
WINEM
THE RFID WINE RACK
A TECHNOLOGY SKETCH FROM THING M
thingm.com

Due Today:

Contextual Inquiry printout due now

Individual heuristic evaluation due online now

Results: IPA2



Stats: with Zeros
- Num: 87
- Mean: 16.19
- Median: 18.0
- Stddev: 5.37

State w/o Zeros
- Num: 81
- Mean: 17.40
- Median: 18.0
- Stddev: 3.18

Grades on bSpace now

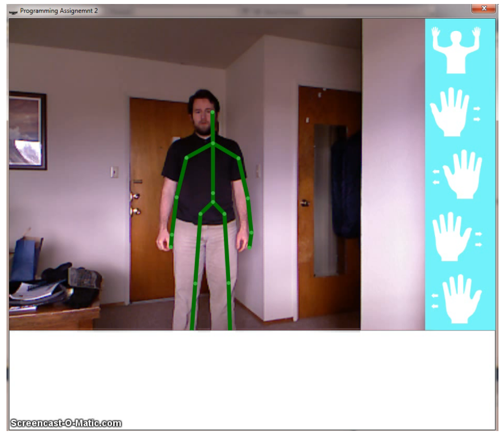
Regrades: Write down where you think you deserve more points and submit physical copy to us. We will regrade entire assignment. Your grade **can decrease** during regrading.

Example: Gesture Recognition

Omar Ali

Good feedback

+ Icons indicate gesture
  - Highlight when detected
  - Left/Right bit hard to distinguish
+ Directional swipes



Example: Drum Playing App

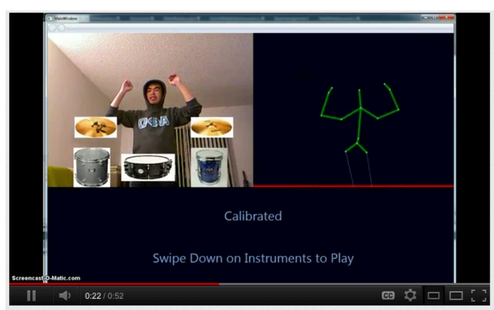
Benjamin Le

Creative application

Well thought out

- Drums icons clear
- Good mapping/layout

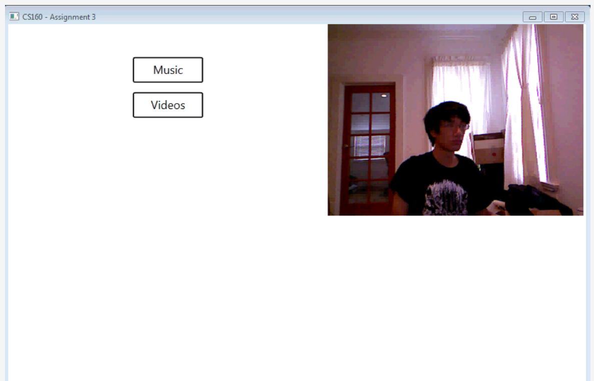
http://www.youtube.com/watch?v=EXp7Ch6qyF8



Assigned: IPA 3 (due Feb 27)

Control your media browser using the Kinect

(Combine IPA1 and IPA 2)



Assignment: Low Fidelity Prototype

Due Mar 7

Identify project mission statement

Create **a low-fidelity paper prototype** that supports 3 tasks

1 easy, 1 moderate, 1 difficult task

Create a video showing your prototype:

How it supports the 3 tasks

Context in which is will be used (back story)

Your video must include narration!

Fitts' Law

$$T = a + b\log_2(D/S + 1)$$

a, b = constants (empirically derived)
D = distance
S = size

ID is Index of Difficulty = $\log_2(D/S+1)$

- Models well-rehearsed selection task
- T increases as the ***distance*** to the target increases
- T decreases as the ***size*** of the target increases

Input Devices

Questions:

What (low-level) tasks are the users trying to accomplish with an input device?

How can we think about the space of possible input devices?

What interaction techniques are encouraged/ discouraged by a particular device?

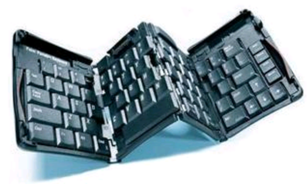
Important Tasks

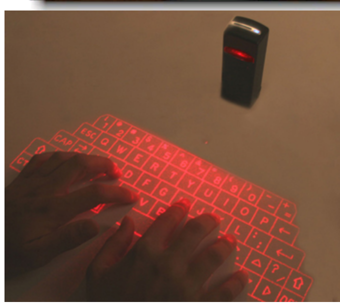
Text Entry

Pointing/Marking

- Target acquisition
- Steering / positioning
- Freehand drawing
- Drawing lines
- Tracing and digitizing
- …

Keyboards





Difficulty: Text Entry

Still very hard on mobile devices

- Keyboards (on-screen and thumb)
- Full hand-writing recognition
- Graffiti
- EdgeWrite
- ShapeWriter

Mobile Text Entry: Keypads

Multi-tap mappings
Multiple presses per letter

Ambiguity resolution
One press per letter, dictionary lookup

18

Mobile Text Entry: Keypads

Chording
Multiple keys pressed simultaneously

Number of combinations for n keys?

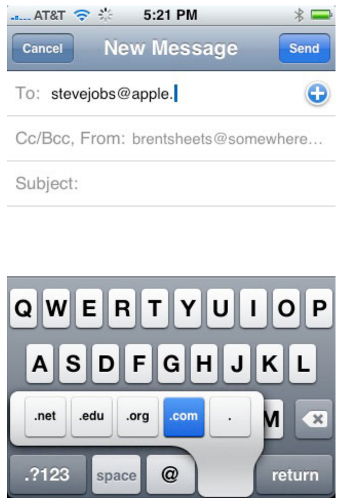
Twiddler2, HandyKey

19

Mobile Text Entry: Soft Keys

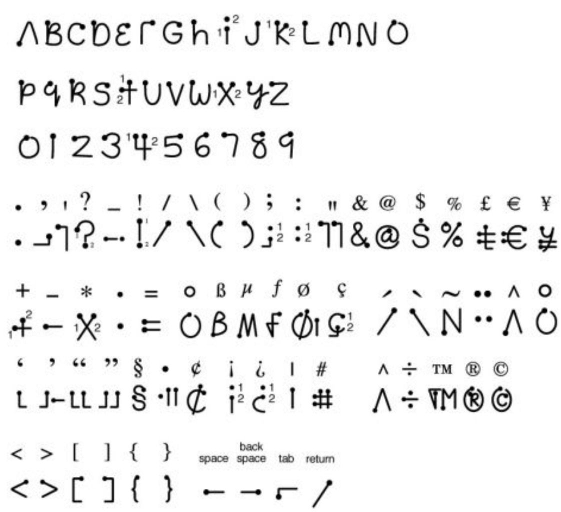
Soft Keyboards

Benefits? Drawbacks?



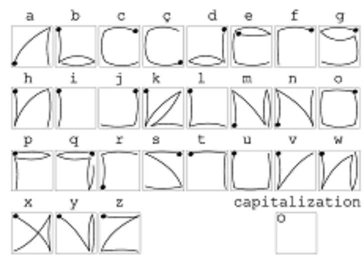
Mactoids.com

Graffiti – Unistroke Text Entry



EdgeWrite

- Corner-based text input technique
- Makes use of physical edges and corners to improve input time
  - why?
- Implementable in many different input modalities
  - stylus, joysticks, trackball



Jacob Wobbrock, UIST 2003

EdgeWrite:

A Stylus-Based Text Entry Method Designed for High Accuracy and Stability of Motion

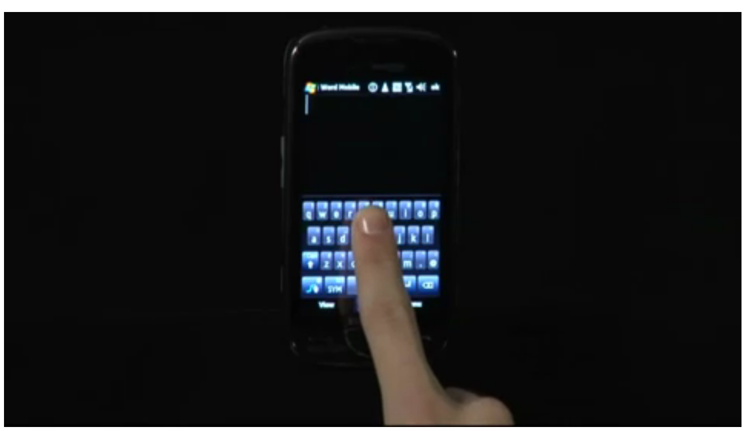
Jacob O. Wobbrock
Brad A. Myers
John A. Kembel
Carnegie Mellon University

UIST 2003 Vancouver, B.C.

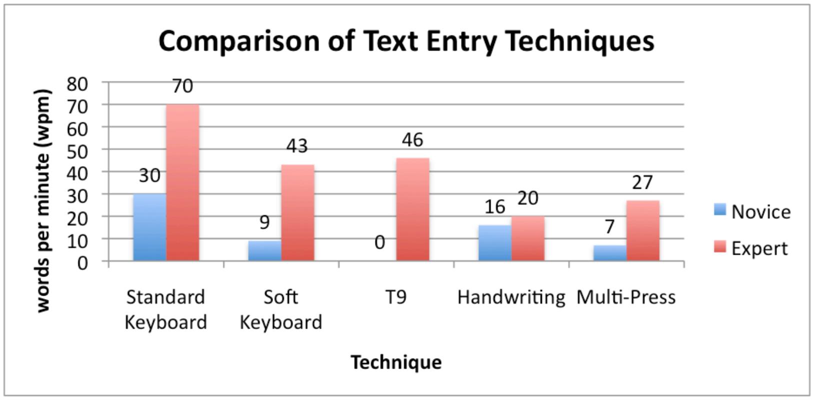
Mobile Text Entry: Handwriting Recog.

Mobile Text Entry: Touch / Stylus

Stroke Entry Methods (e.g., Swype, ShapeWriter)



Which is fastest?



What about Speech Recognition?

Dictation is faster than typing (~100 wpm)

What about Speech Recognition?

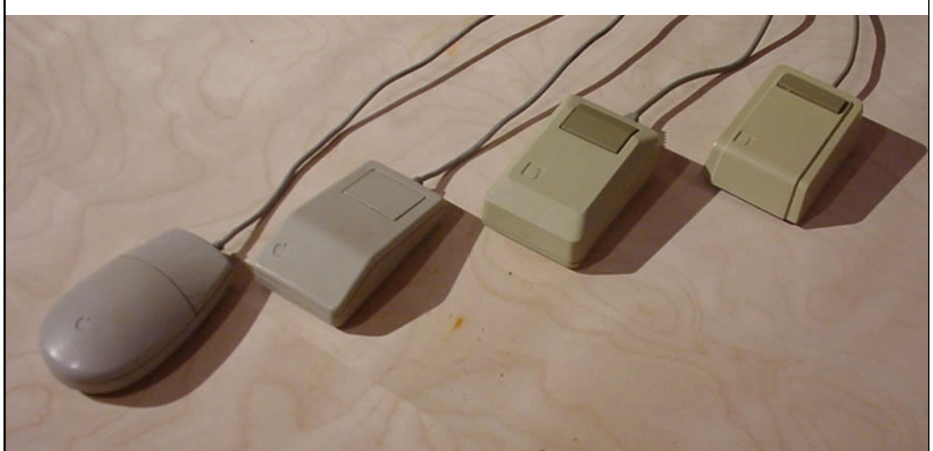
Dictation is faster than typing (~100 wpm), BUT:

Speech is different from written language:
Speaking in well-formed, complete, print-ready sentences is cognitively challenging

High cost of correcting errors through speech channel alone

Social awkwardness?

Pointing Devices

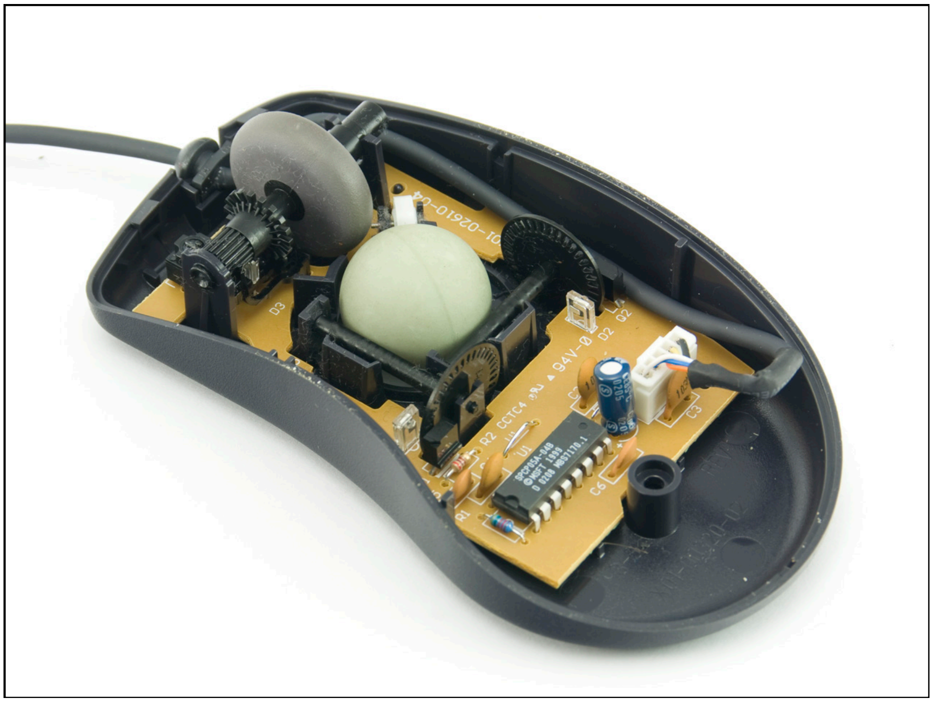


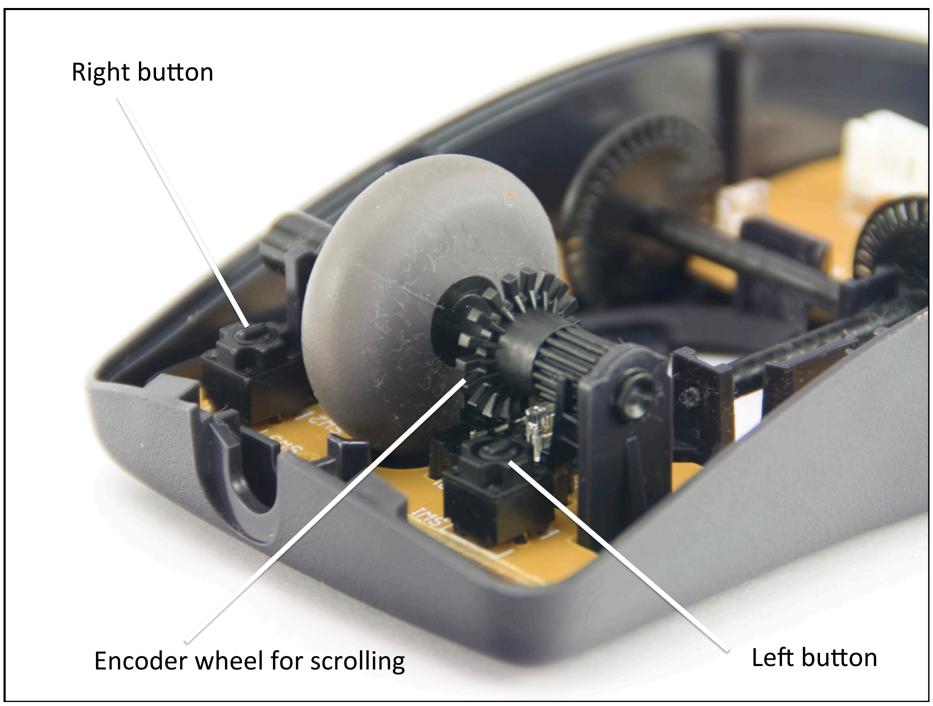
(cc) Flickr photo by Mike fj40

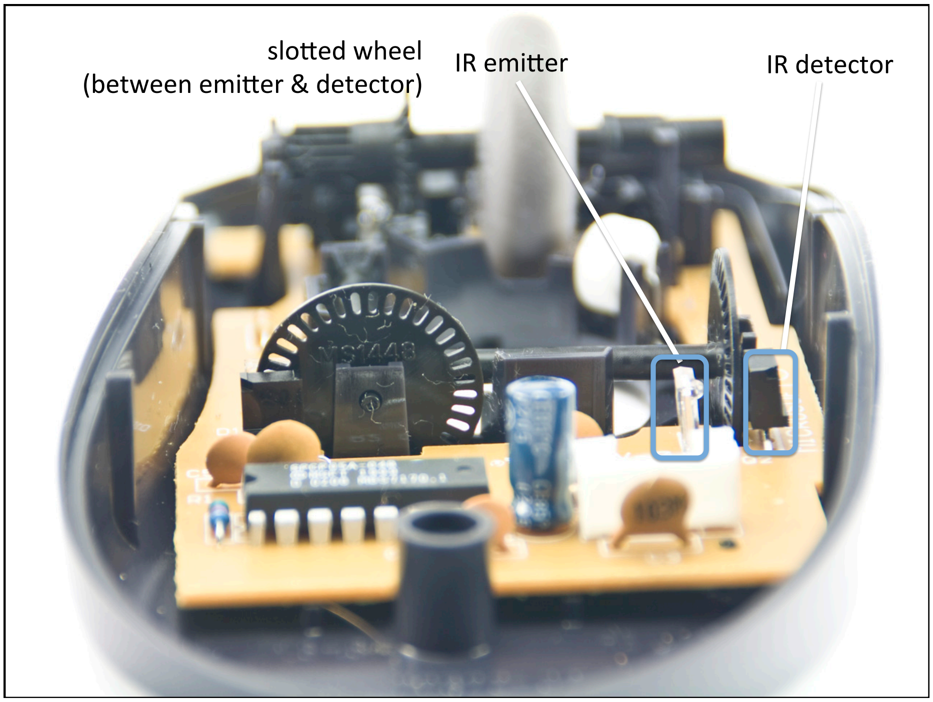
31


Mouse. Engelbart and English ~1964
Source: Card, Stu. Lecture on Human Information Interaction. Stanford, 2007.

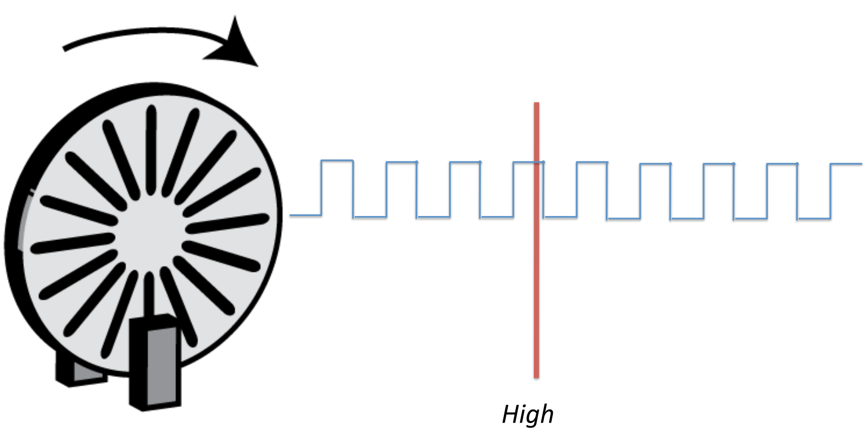

DELL
by Microsoft




Right button
Encoder wheel for scrolling
Left button

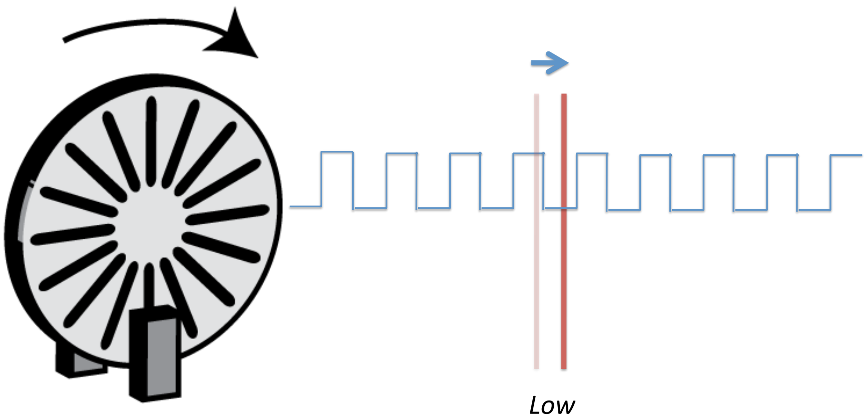


Sensing: Rotary Encoder



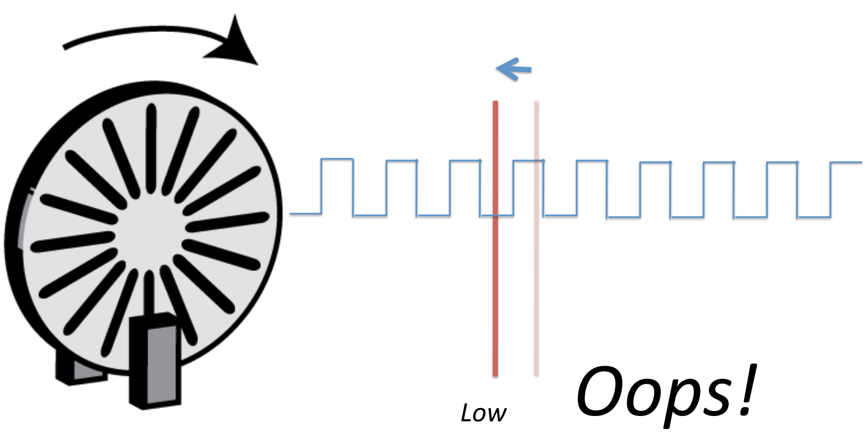
37

Sensing: Fwd Rotation



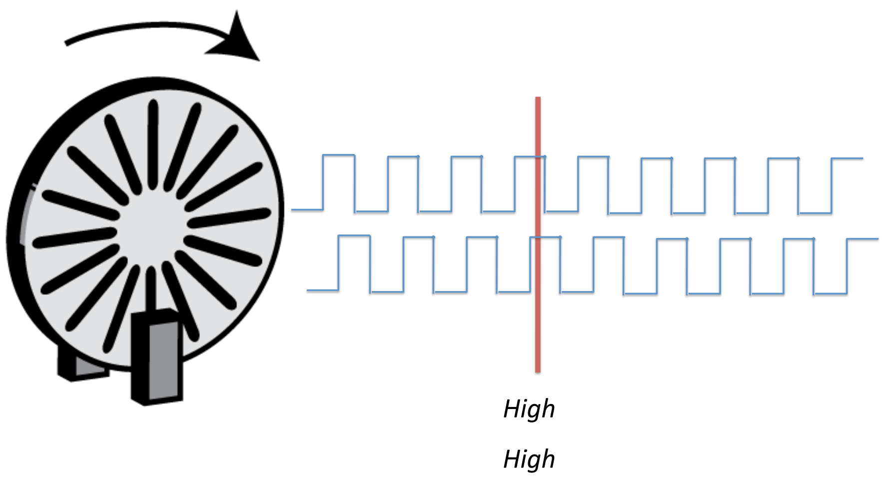
38

Sensing: Backwd Rotation

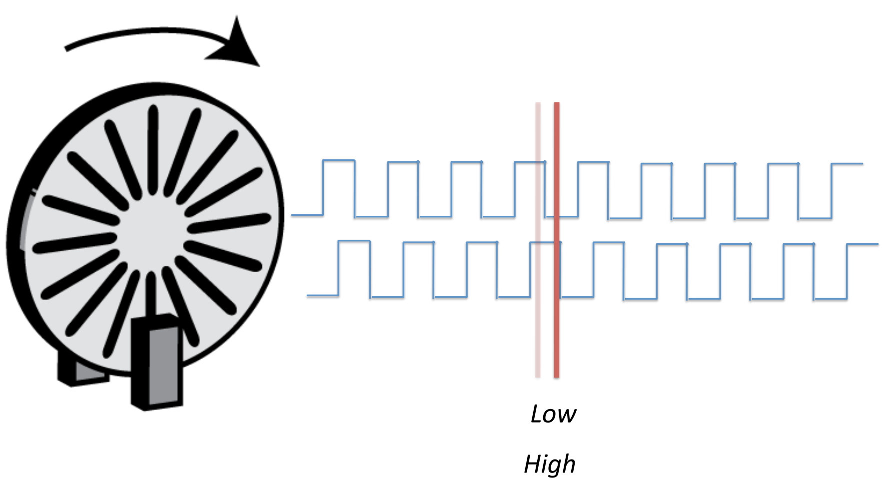


39

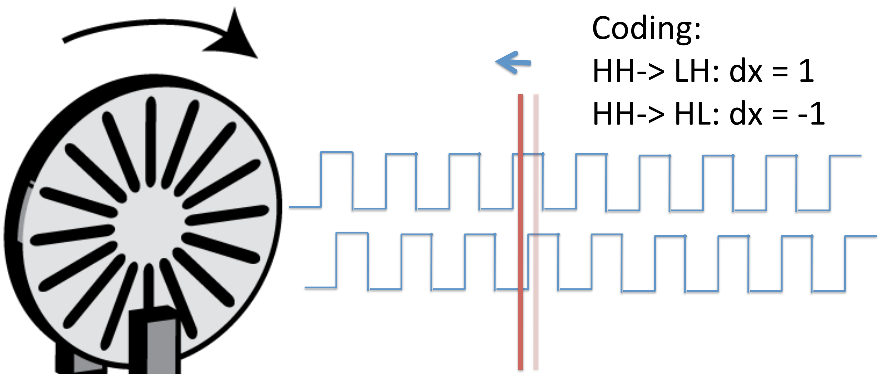
Solution: Use two out-of-phase detectors



Sensing: Rotary Encoder



Sensing: Rotary Encoder



Coding:
HH-> LH: dx = 1
HH-> HL: dx = -1

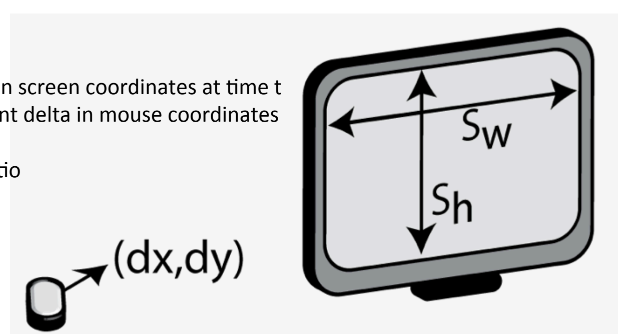
42

Transformation

cx_t = max(0, min(sw, cx_{t-1}+dx*cd))

cy_t = …

cx_t: cursor x position in screen coordinates at time t
dx: mouse x movement delta in mouse coordinates
sw: screen width
cd: control-display ratio

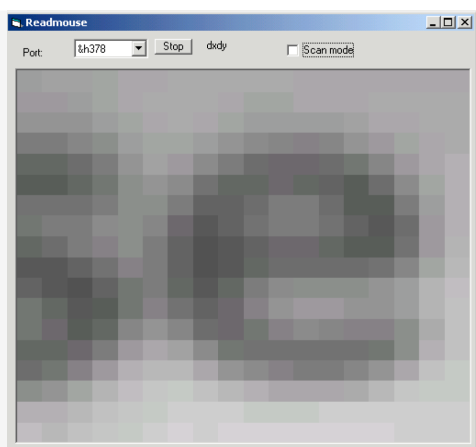


43

Device Abstraction

Click, DoubleClick, MouseUp, MouseDown, MouseMove …

What about optical mice?



Source: http://spritesmods.com/?art=mouseeye

What is sensed?

Table I. Physical Properties Used by Input Devices

	Linear	Rotary
Position		
Absolute	Position P	Rotation **R**
Relative	Movement **dP**	Delta rotation **dR**
Force		
Absolute	Force **F**	Torque **T**
Relative	Delta force **dF**	Delta torque **dT**

Card, S. K., Mackinlay, J. D., and Robertson, G. G. 1991. A morphological analysis of the design space of input devices. *ACM Trans. Inf. Syst.* 9, 2 (Apr. 1991), 99-122.

Other device properties:

Indirect vs. Direct

Direct: Input and output space are unified

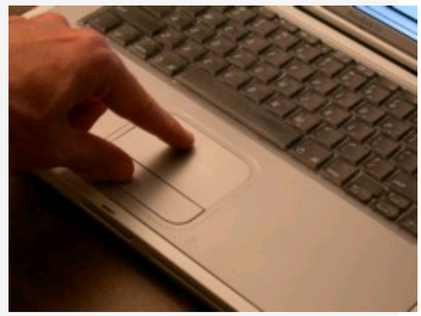
C:D Ratio

For one unit of movement in physical space, how far does the cursor travel in display space?

Q: What is the C:D ratio for direct touch screen input?

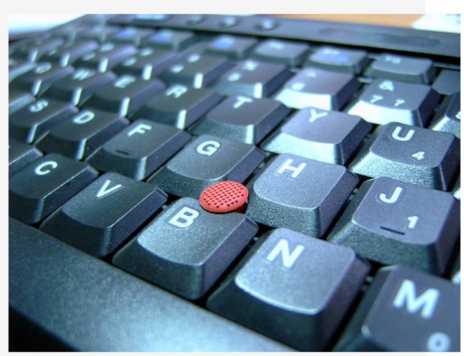
Device Acquisition Time

Trackball, Trackpad



Trackpoint

- Indirect, force sensing, velocity control
- Nonlinear transfer function



(cc) Image by flickr user tsaiid

Mobile Pointing

D-Pad
(see: arrow keys)

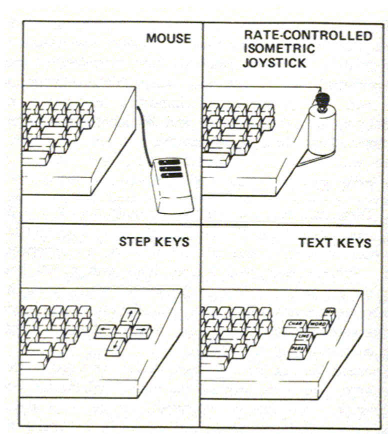
Trackball

Direct touch
(see: Trackpad)

Stylus

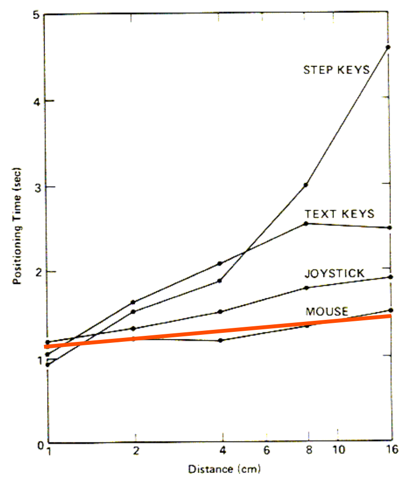
Which is faster?

Engelbart



Source: Card, Stu. Lecture on Human Information Interaction. Stanford, 2007.

Experiment: Mice are fastest!



Source: Card, Stu. Lecture on Human Information Interaction. Stanford, 2007.

Fitts' Law

Time T_{pos} to move the hand to target size S which is distance D away is given by:

$$T_{pos} = a + b \underbrace{\log_2 (D/S + 1)}_{\textit{Index of Difficulty (ID)}}$$

Index of Difficulty (ID)

Only *relative precision* matters

Source: Landay, James. "Human Abilities". CS160 UC Berkeley.

Fitts' Law

Time T_{pos} to move the hand to target size S which is distance D away is given by:

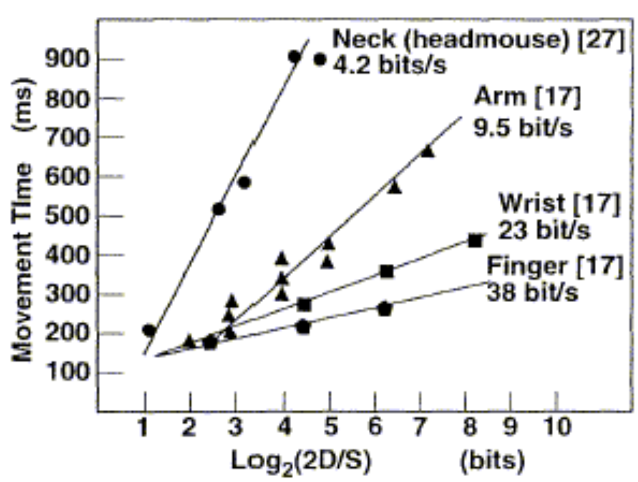
$$T_{pos} = a + b \log_2 (D/S + 1)$$

Device Characteristics
(bandwidth of human muscle group & of device)

a: start/stop time
b: speed

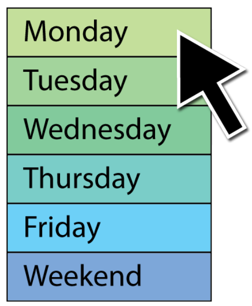
Source: Landay, James. "Human Abilities". CS160 UC Berkeley.

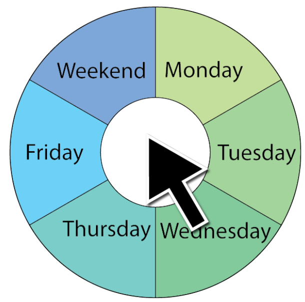
Bandwidth of Human Muscle Groups



Source: Card, Stu. Lecture on Human Information Interaction. Stanford, 2007.

Fitts' Law Example



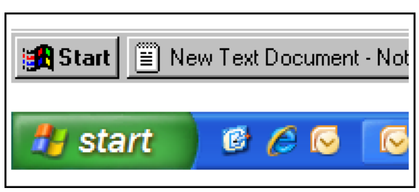


Which will be faster on average?

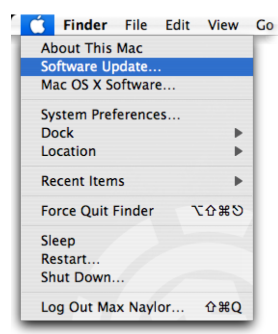
pie menu (bigger targets & less distance)

Source: Landay, James. "Human Abilities". CS160 UC Berkeley.

Fitts' Law in Windows & Mac OS



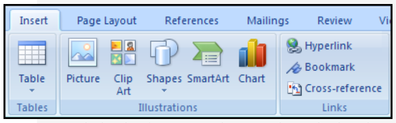
Windows 95: Missed by a pixel
Windows XP: Good to the last drop



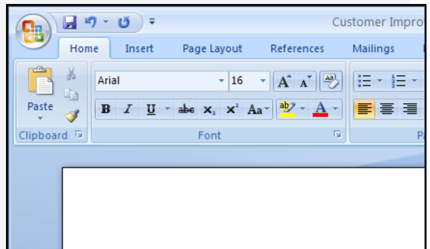
The Apple menu in
Mac OS X v10.4 Tiger.

Source: Jensen Harris, An Office User Interface Blog : Giving You Fitts. Microsoft, 2007; Apple

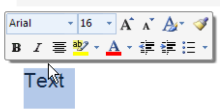
Fitts' Law in Microsoft Office 2007



Larger, labeled controls can be clicked more quickly



Magic Corner: Office Button in the upper-left corner



Mini Toolbar: Close to the cursor

Source: Jensen Harris, An Office User Interface Blog : Giving You Fitts. Microsoft, 2007.

Everything is best for something and worst for something else.

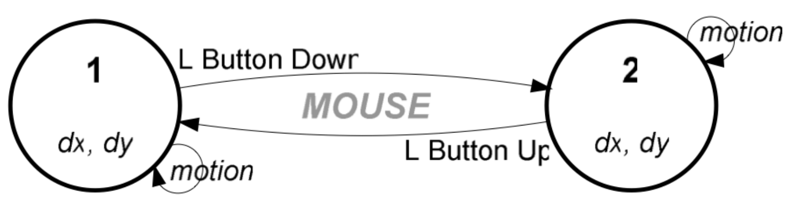
- Bill Buxton

3-State Model of Input (Buxton)

State	Description
0	*Out Of Range:* The device is not in its physical tracking range.
1	*Tracking:* Device motion moves only the cursor.
2	*Dragging:* Device motion moves objects on the screen.

(Table from Hinckley Reading)

Mouse



(Figure from Hinckley Reading)

State	Description
0	*Out Of Range:* The device is not in its physical tracking range.
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Touch Screen

(Figure from Hinckley Reading)

State	Description
0	*Out Of Range:* The device is not in its physical tracking range.
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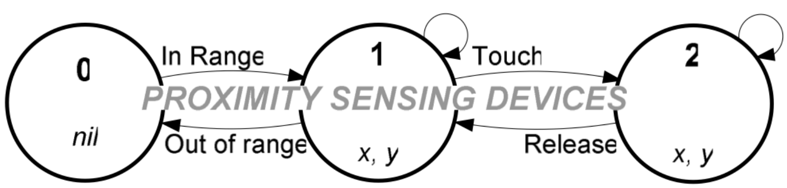
2	*Dragging:* Device motion moves objects on the screen.

Stylus on Tablet



(Figure from Hinckley Reading)

State	Description
0	*Out Of Range:* The device is not in its physical tracking range.
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Mouse, in more detail