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

Stats: without 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=ELxp7CM4ylf8
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

\[ T = a + b \log_2 \left( \frac{D}{S + 1} \right) \]

- \(a, b\) = 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

Still very hard on mobile devices
Keyboard (on-screen and thumb)
Full hand-writing recognition
Graffiti
EdgeWrite
ShapeWriter

Difficulty: Text Entry
Mobile Text Entry: Keypads

**Multi-tap mappings**
Multiple presses per letter

**Ambiguity resolution**
One press per letter; dictionary lookup

Mobile Text Entry: Keypads

**Chording**
Multiple keys pressed simultaneously

Number of combinations for n keys?
Mobile Text Entry: Soft Keys

Soft Keyboards
Benefits? Drawbacks?

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
Mobile Text Entry: Handwriting Recog.

Mobile Text Entry: Touch / Stylus

Stroke Entry Methods (e.g., Swype, ShapeWriter)
Which is fastest?

![Comparison of Text Entry Techniques]

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
Mouse  Engelbart and English '1964

Right button

Encoder wheel for scrolling

Left button
Sensing: Rotary Encoder
Sensing: Fwd Rotation

Sensing: Backwd Rotation

Oops!
Solution: Use two out-of-phase detectors

Sensing: Rotary Encoder
Sensing: Rotary Encoder

Codings:
HH-> LH: \( dx = 1 \)
HH-> HL: \( dx = -1 \)

Transformation

\[
\begin{align*}
cx_t &= \max(0, \min(sw, cx_{t-1} + dx*cd)) \\
cy_t &= \ldots
\end{align*}
\]

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

(dx, dy)
Device Abstraction

Click, DoubleClick, MouseUp, MouseDown, MouseMove ...

What about optical mice?

Source: http://spritesmods.com/?art=mouseeye
What is sensed?

<table>
<thead>
<tr>
<th>Physical Properties Used by Input Devices</th>
</tr>
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<tbody>
<tr>
<td><strong>Linear</strong></td>
</tr>
<tr>
<td>Position</td>
</tr>
<tr>
<td>Absolute</td>
</tr>
<tr>
<td>Relative</td>
</tr>
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What is the C:D ratio for direct touch screen input?

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

Indirect, force sensing, velocity control
Nonlinear transfer function
Mobile Pointing

- D-Pad
  (see: arrow keys)
- Trackball
- Direct touch
  (see: Trackpad)
- Stylus

Which is faster?

- Engelbart

Experiment: Mice are fastest!

Fitts’ Law

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

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

Index of Difficulty (ID)

Only relative precision matters

Fitts’ Law

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

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

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

$a$: start/stop time

$b$: speed


Bandwidth of Human Muscle Groups

Fitts’ Law Example

Which will be faster on average?
pie menu (bigger targets & less distance)


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.

Fitts’ Law in Microsoft Office 2007

Larger, labeled controls can be clicked more quickly.


Everything is best for something and worst for something else.

- Bill Buxton
3-State Model of Input (Buxton)

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<td>2</td>
<td><em>Dragging</em>: Device motion moves objects on the screen.</td>
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(Table from Hinckley Reading)

Mouse

(Figure from Hinckley Reading)
**Touch Screen**

(Figure from Hinckley Reading)

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**Stylus on Tablet**

(Figure from Hinckley Reading)

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Mouse, in more detail

1 Hover
  \( dx, dy \)
  \( \Delta t > T_{out};\ dx, dy < \epsilon_{enter} \)
  L Button Down
  R Button Down

2 Drag
  \( dx, dy \)
  L Button Up (Drop)
  \( dx, dy > \epsilon_{drag} \)

1
  \( dx, dy \)
  L Button Up (Click)
  R Button Down

2 Left
  \( dx, dy \)

2 Right
  \( dx, dy \)
  R Button Up (R Click)