Lecture 7 Text Entry on Mobile Devices

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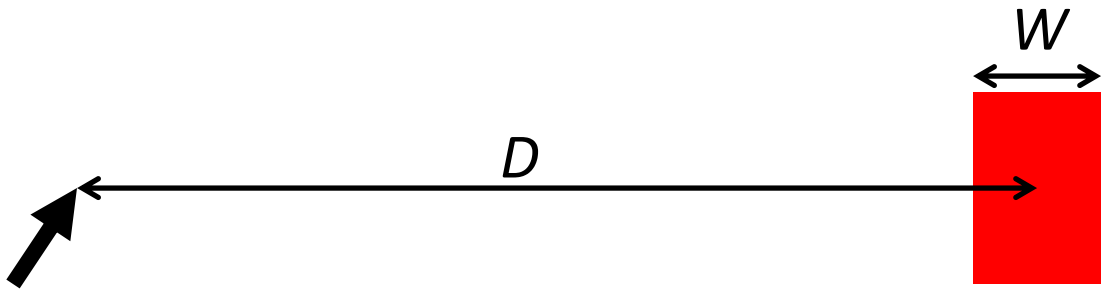
Fitts' Law

Paul Fitts, 1954



$$\underbrace{MT}_{\text{Movement Time}} = a + \underbrace{b \log_2 \left(\frac{D}{W} + 1\right)}_{\text{Index of Difficulty (}ID\text{ [bits])}}$$

Hick's Law

Uncertainty Principle. Decision time T increases with uncertainty about the judgment or decision to be made:

$$T = I_C H,$$

where H is the information-theoretic entropy of the decision and I_C = 150 [0–157] ms/bit. For n equally probable alternatives (called Hick's Law),

$$H = \log_2 (n + 1).$$

For n alternatives with different probabilities p_i of occurrence,

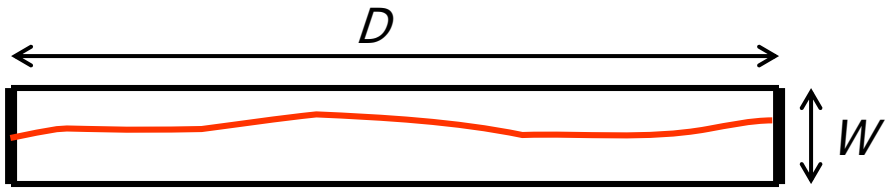
$$H = \Sigma_i p_i \log_2 (1/p_i + 1).$$

Steering Law *(Accot and Zhai, 1997)*

"Beyond Fitts' Law: Models for trajectory based HCI tasks."
Proceedings of ACM CHI 1997 Conference

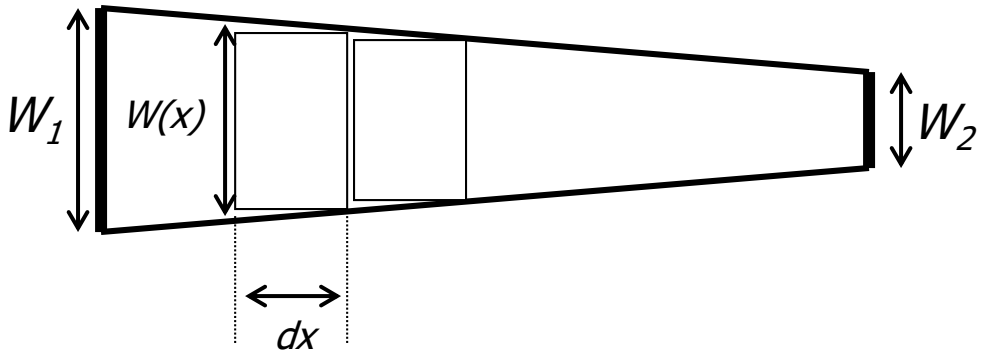
fixed width tunnel:

$$ID = \frac{D}{W}, \quad MT = a + b\frac{D}{W}$$



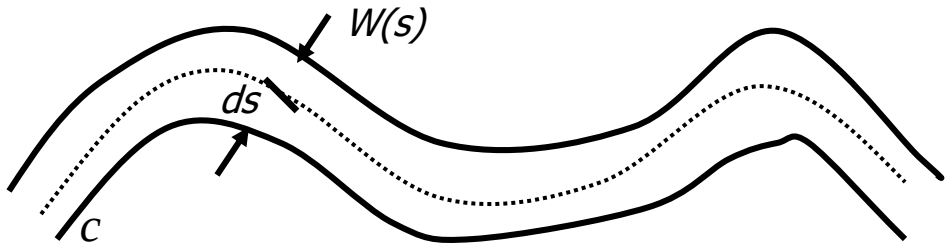
narrowing tunnel:

$$ID = \int_0^D \frac{dx}{W(x)}$$

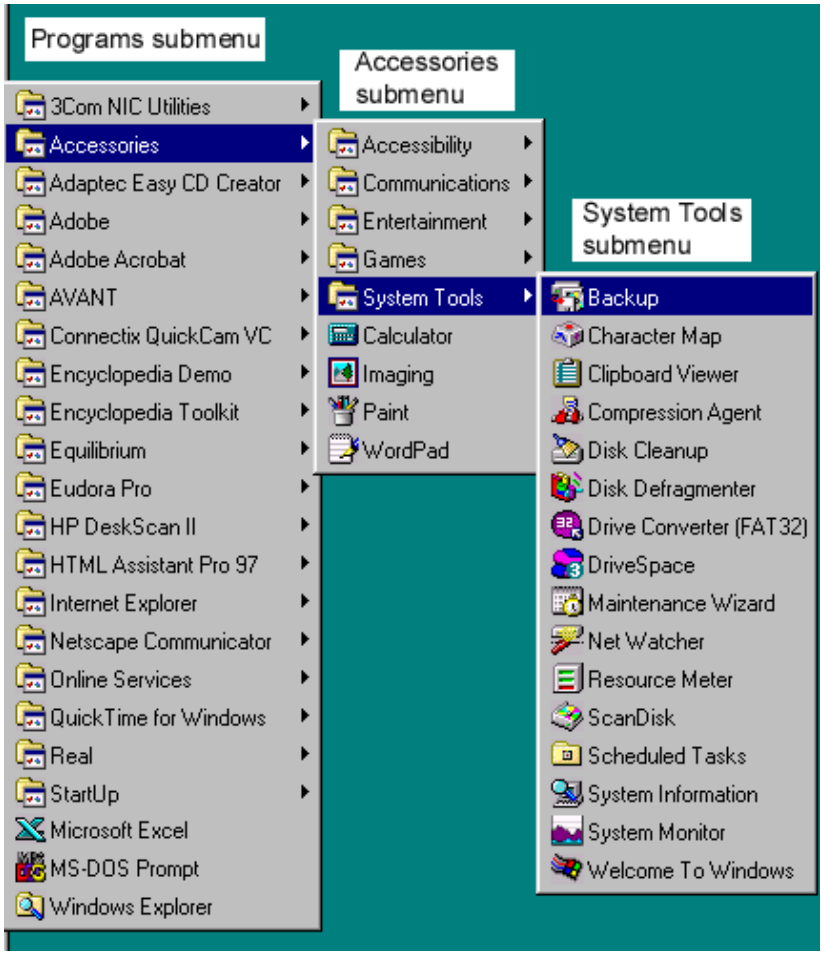


general Steering Law:

$$ID = \int_c \frac{ds}{W(s)}$$



Example: Modeling Menu Performance



Andy Cockburn, Carl Gutwin, and Saul Greenberg. 2007. A predictive model of menu performance. In *CHI '07*. ACM, New York, NY, USA, 627-636.

GOMS

- A family of user interface modeling techniques

- Goals, Operators, Methods, and Selection rules
  - Input: detailed description of UI and task(s)
  - Output: various qualitative and quantitative measures

- **Top Three Activities on Mobile Devices:**
  1) Emailing, 2) Social Networking, 3) Messaging (www.time.com)

- **18 to 24 Year Olds Average 110 Text Messages per Day** (www.time.com)

Challenges of Touchscreen Text Entry

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Determined by key boundaries, 50% of words are not correctly typed on phone.

Unsuccessful Auto-correction

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Outline

- Smart Touch Keyboard
- Gesture Typing
- Optimizing Keyboard Layouts

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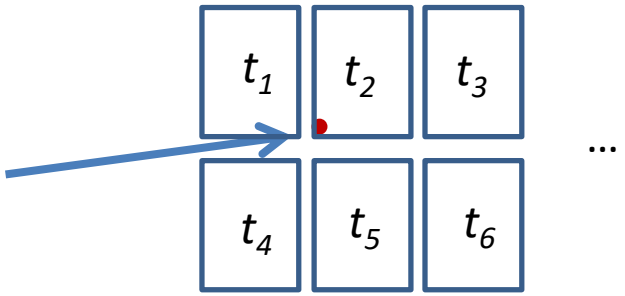
Smart Touch Keyboard

Principles of Target Selection

n target candidates: $T = \{t_1, t_2, \ldots, t_n\}$

touch point: s



[**Bi,** Zhai. *Bayesian Touch.* ACM UIST2013]

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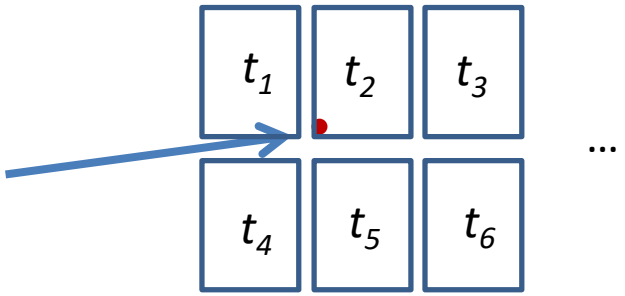

Determining the target:

$$t^* = \underset{t}{argmax}\, P(t|s)$$

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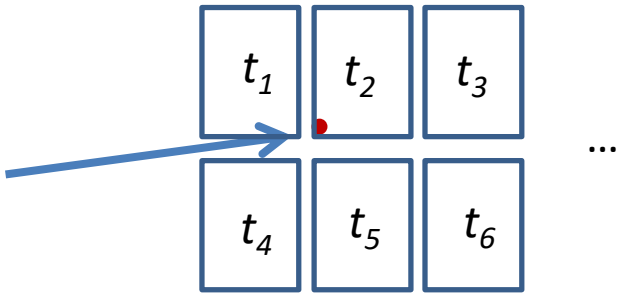

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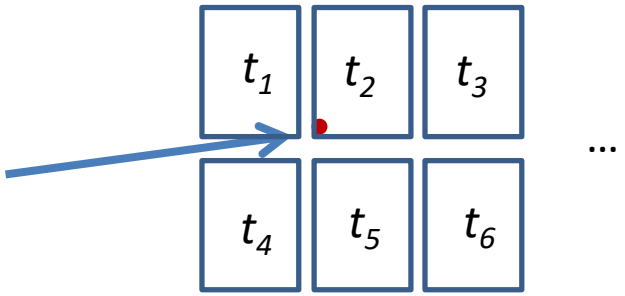

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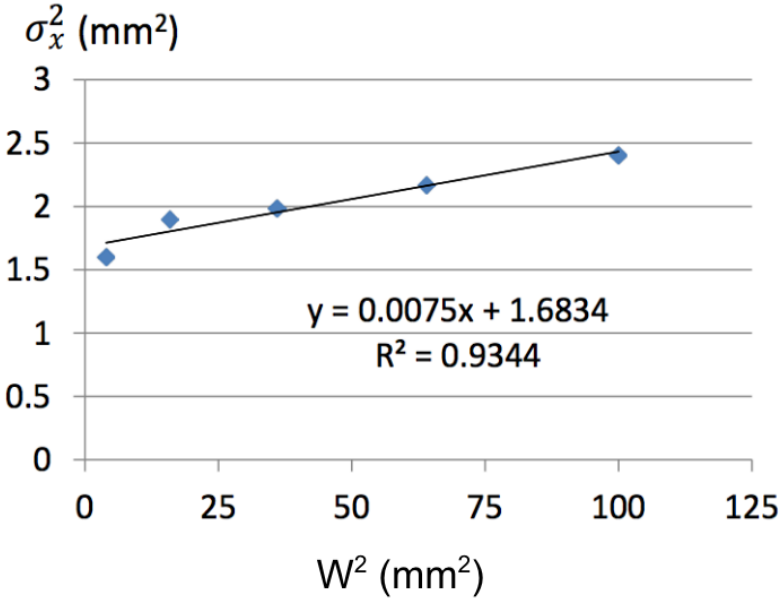
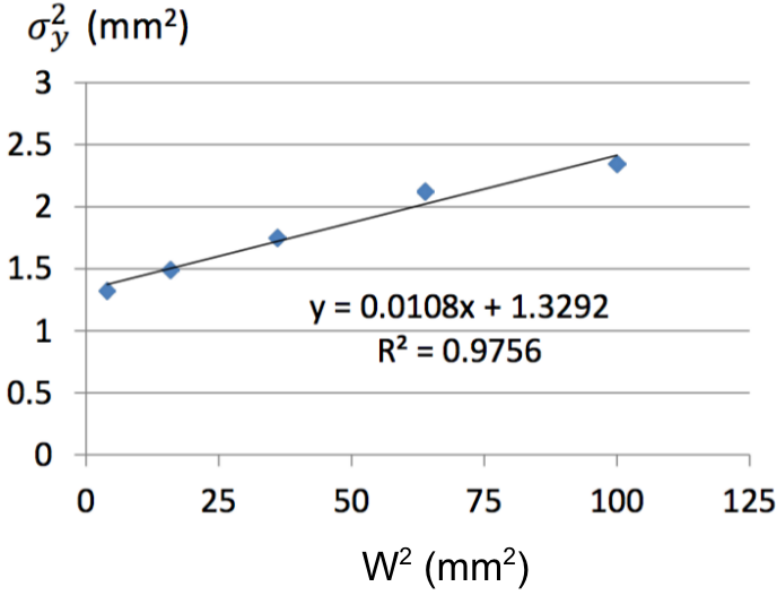
Dual Gaussian Distribution Model

$$\sigma^2 = \sigma_r^2 + \sigma_a^2 = \alpha W^2 + \sigma_a^2$$





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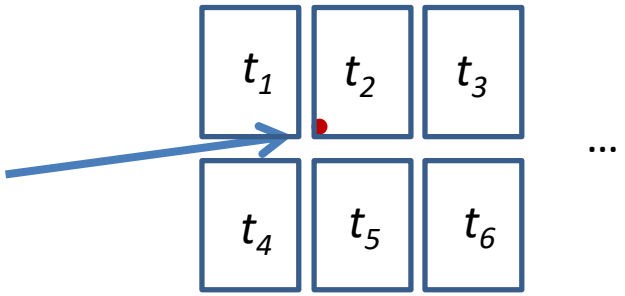

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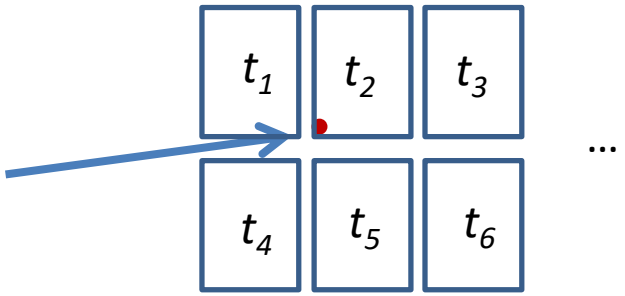

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$P(t)$: prior probability

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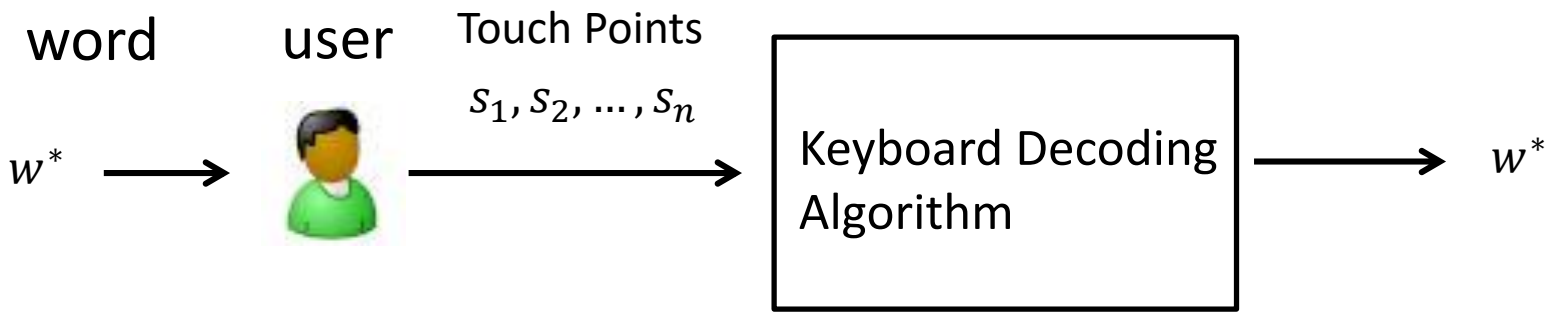
Text Entry Decoding Algorithm

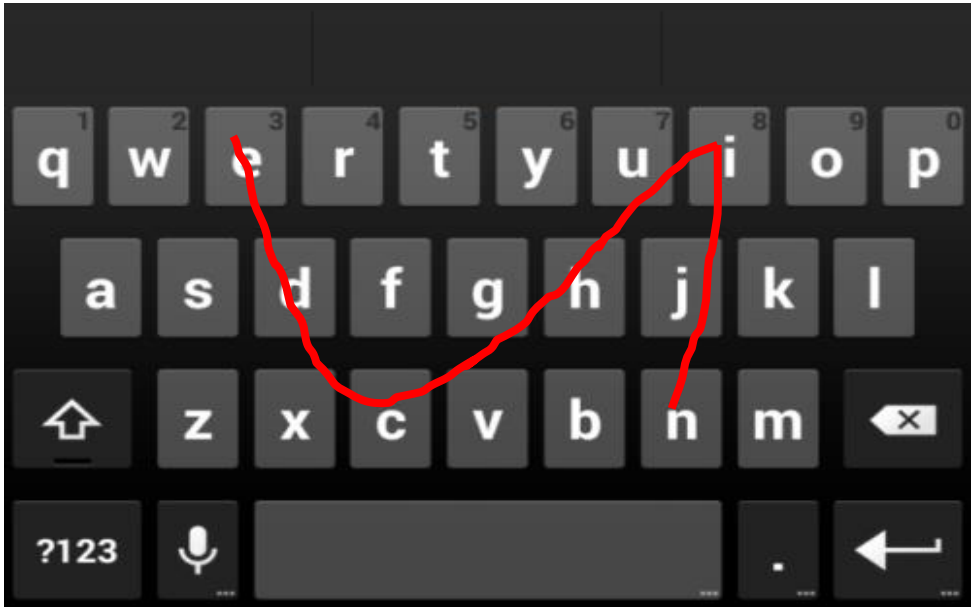


Outline

- Smart Touch Keyboard
- Gesture Typing
- Optimizing Keyboard Layouts

Gesture Keyboard

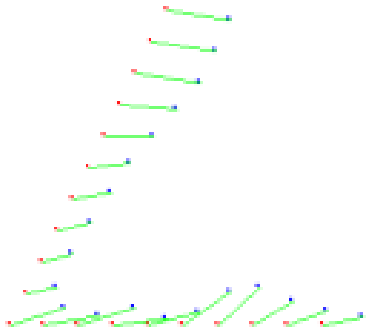
Entering *nice*



SHARK^2 Algorithm

- Location Recognition Channel

$$x_s = \frac{1}{N}\sum_{i=1}^{N}\|u_i - t_i\|_2$$



- Shape Matching Channel

Per-Ola Kristensson and Shumin Zhai. 2004. SHARK^2: a large vocabulary shorthand writing system for pen-based computers. In *UIST '04*. 43-52.

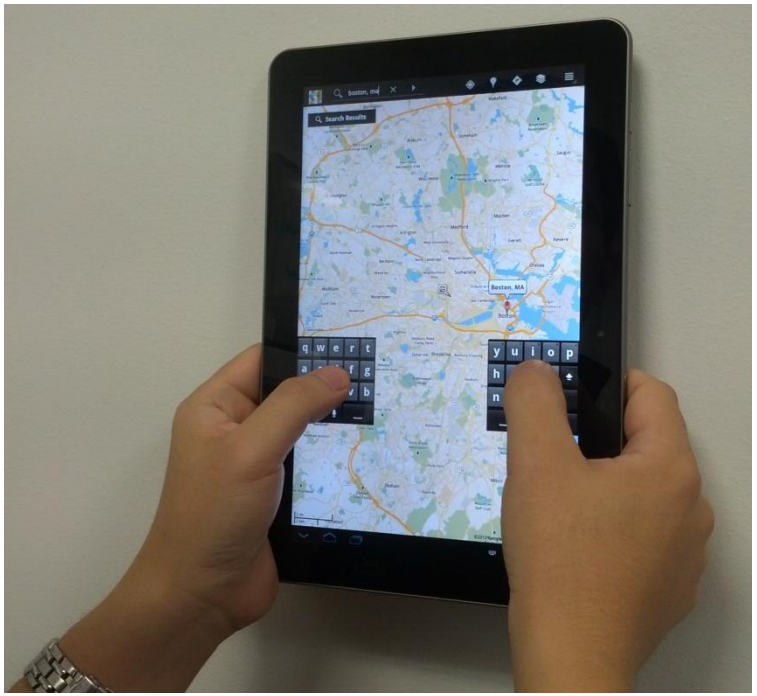
Gesture Keyboard

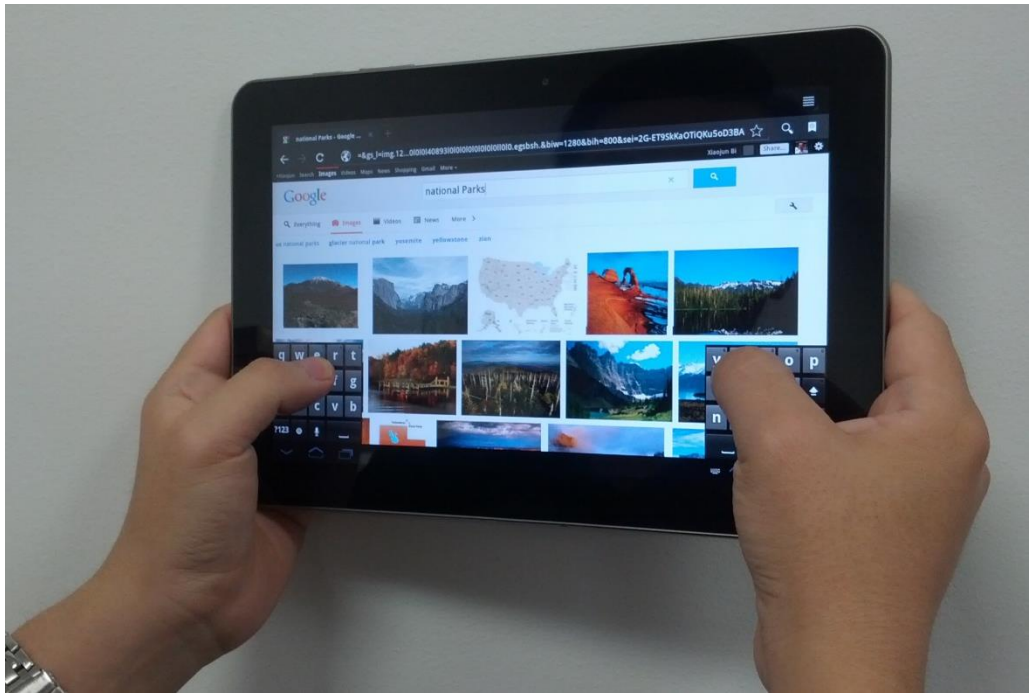
ShapeWriter

Android

Swype

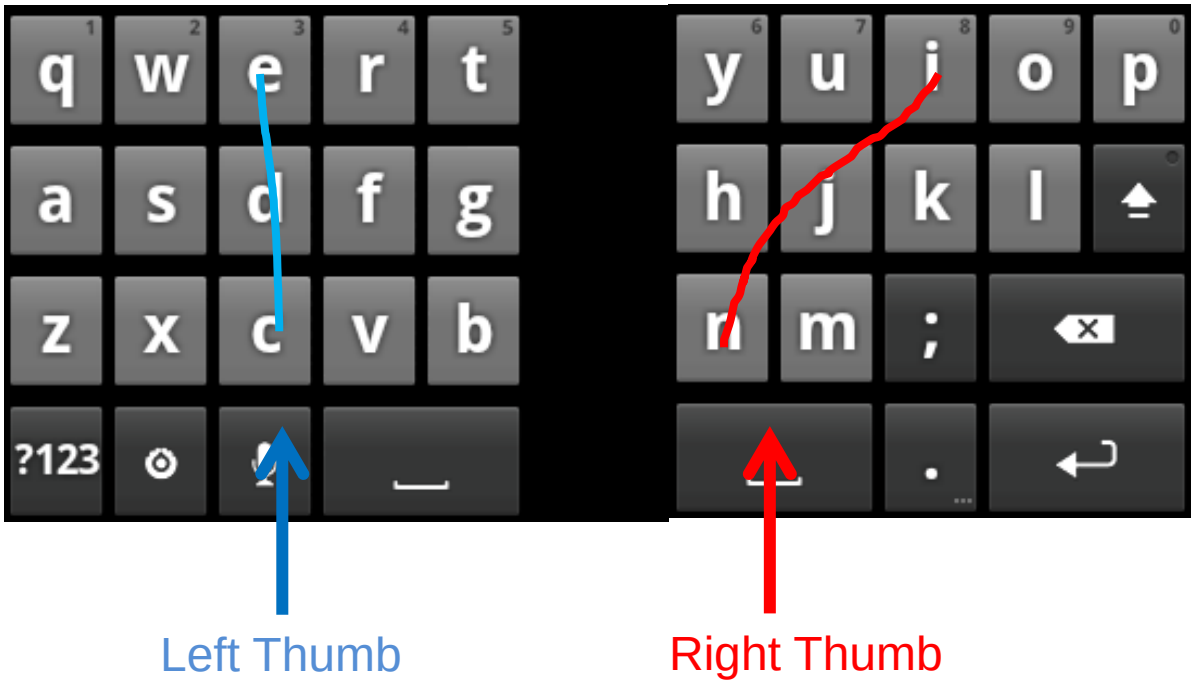
TouchPal


Search Results
Boston, MA


Google
national Parks

Bimanual Gesture Typing

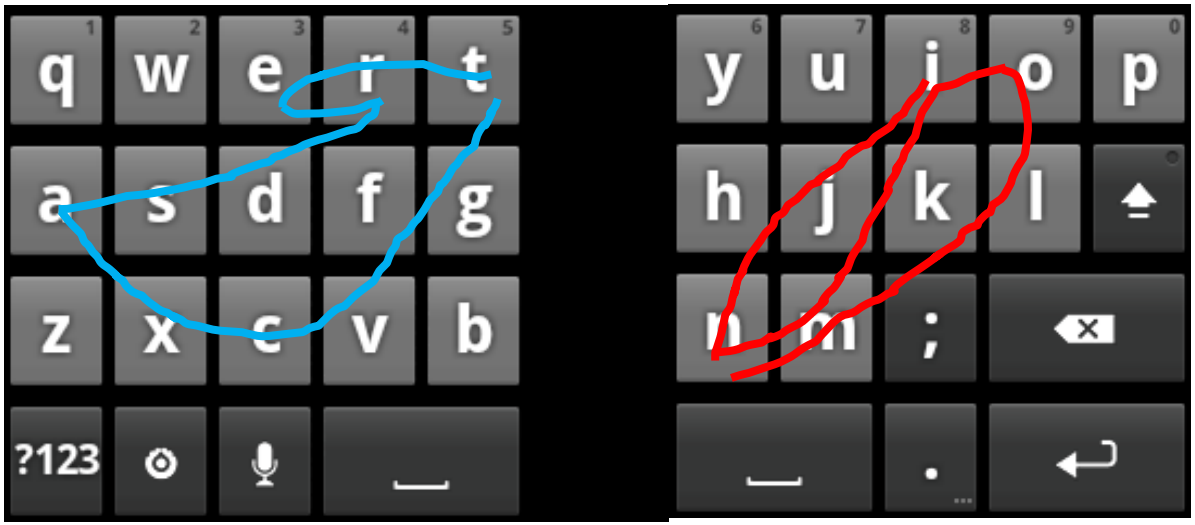
Entering *nice*



[**Bi,** Chelba, Ouyang, Partridge, Zhai. *Bimanual Gesture Keyboard.* ACM UIST2012]

Bimanual Gesture Typing

Entering *interaction*



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