Lecture 7 Text Entry on Mobile Devices -1

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- **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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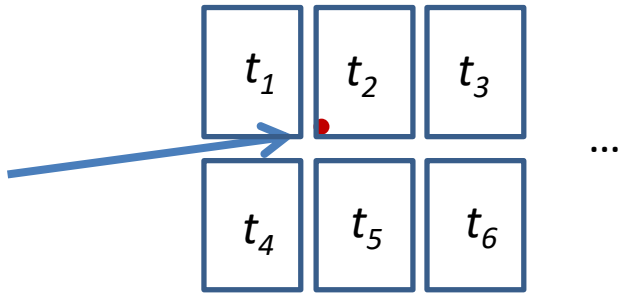
Smart Touch Keyboard

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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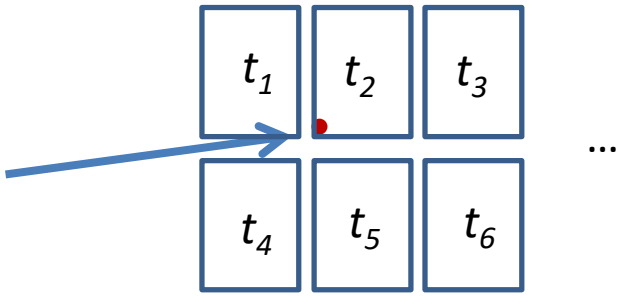

Determining the target:

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

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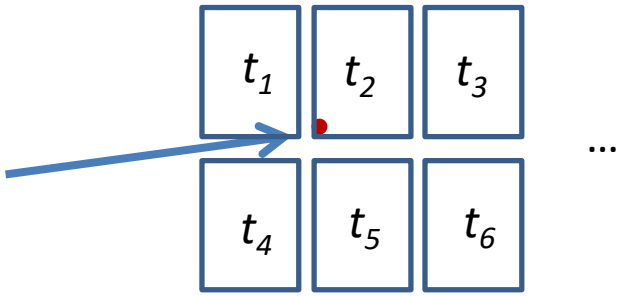

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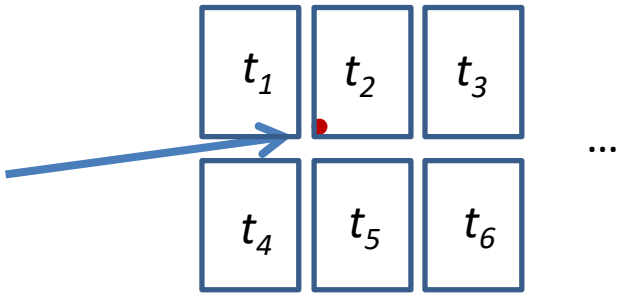

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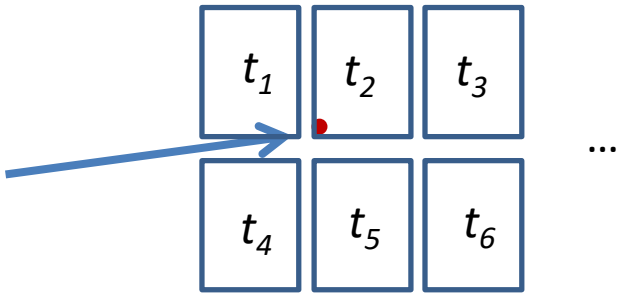

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$P(t)$: prior probability

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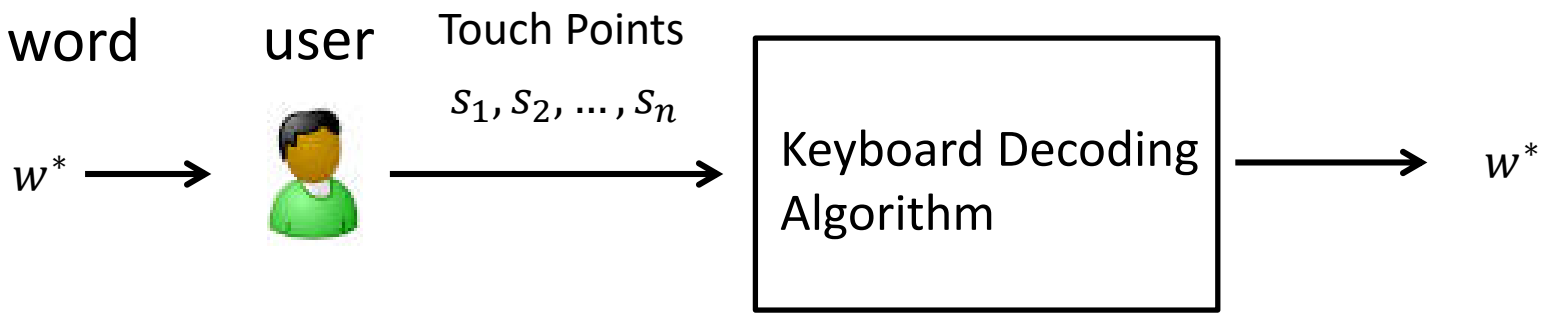
Principles of Smart Touch Keyboard



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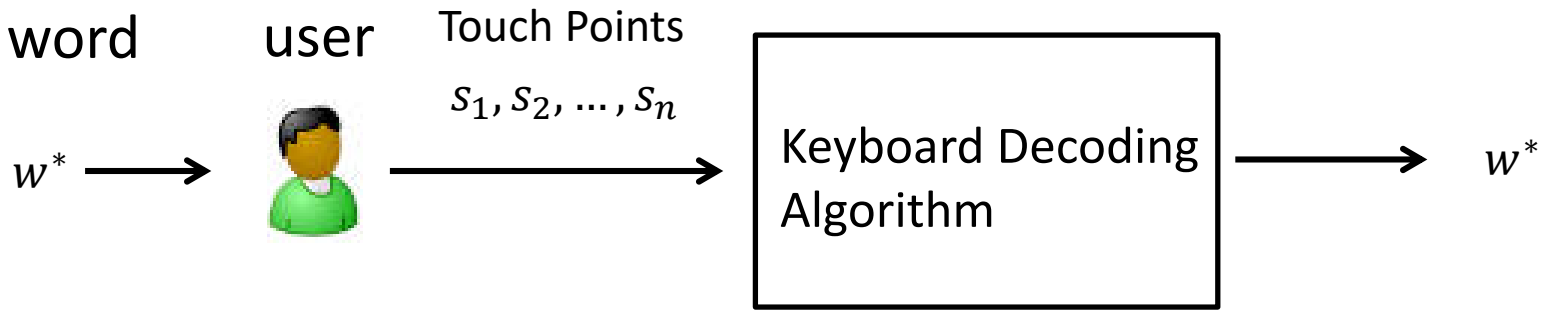
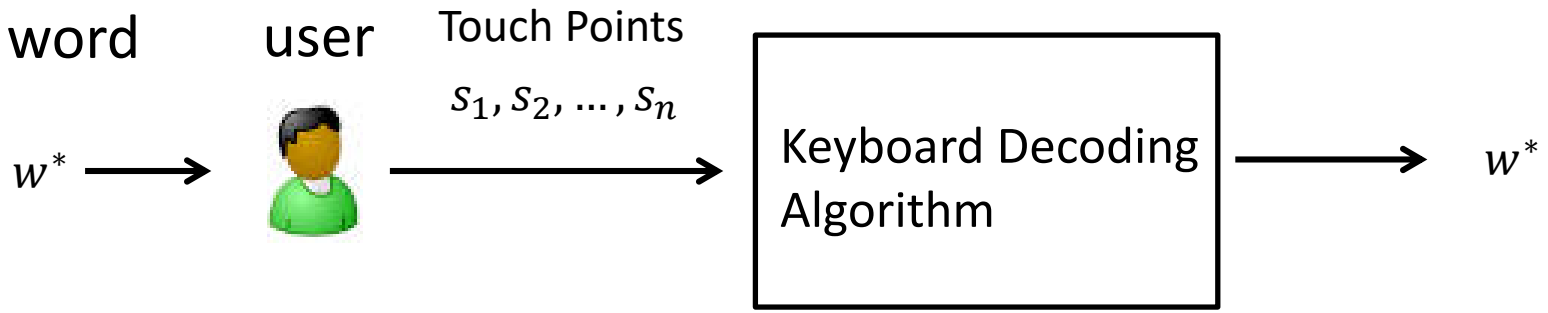


$$w^* = \underset{w}{argmax}\, P(w|s_1, s_2, \ldots, s_n)$$

Principles of Smart Touch Keyboard



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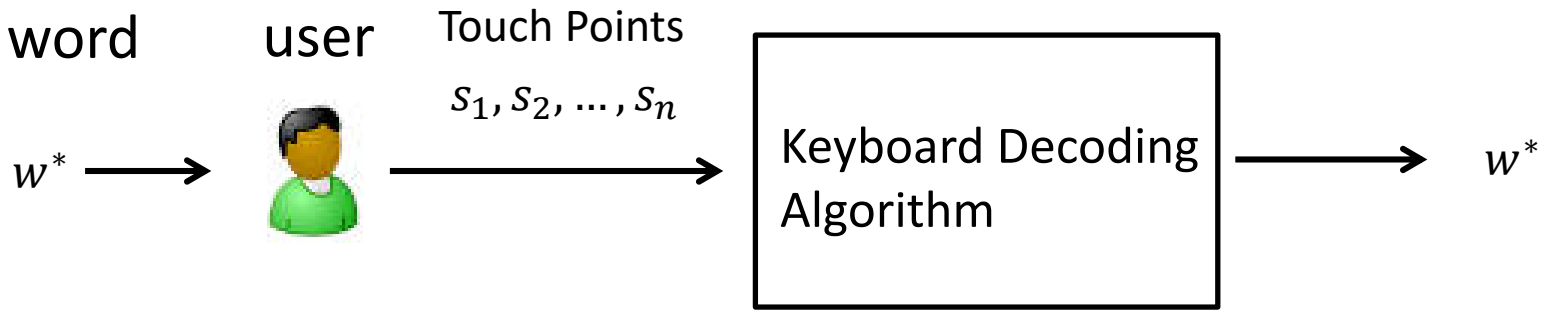
$$P(w|s_1, s_2, \dots, s_n) = \frac{P(s_1, s_2, \dots, s_n|w\,)P(w)}{P(s_1, s_2, \dots, s_n)}$$

Principles of Smart Touch Keyboard



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$P(w)$: probability from language model

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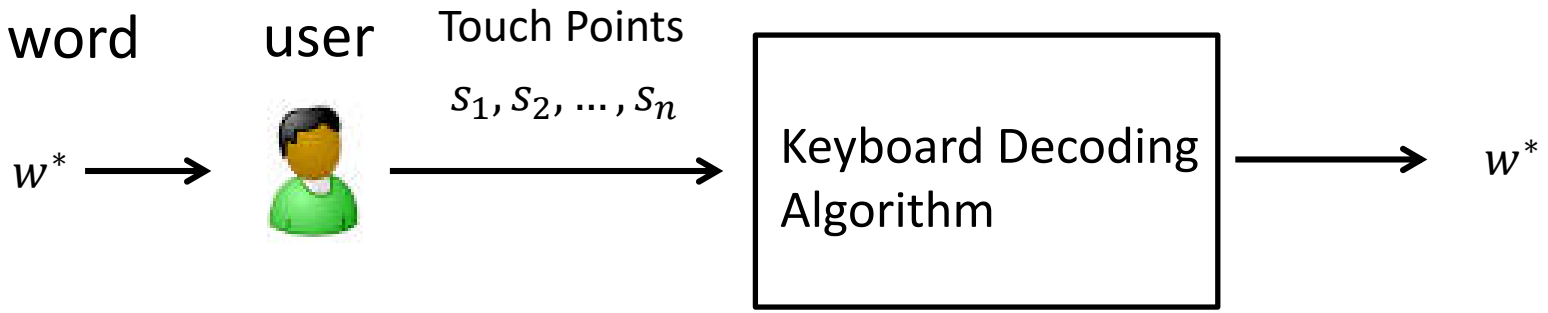

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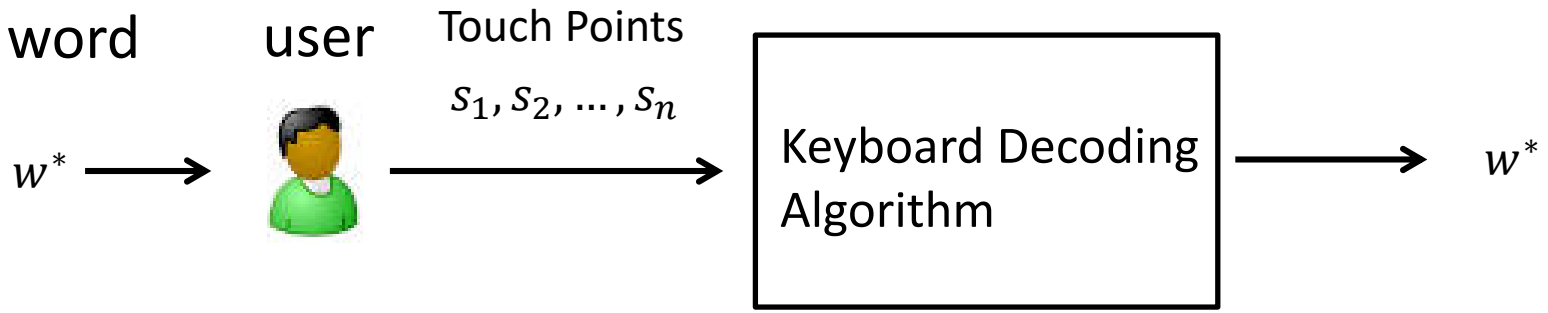
$P(w)$: probability from language model

$P(s_1, s_2, \dots, s_n|w\,)$?

Principles of Smart Touch Keyboard

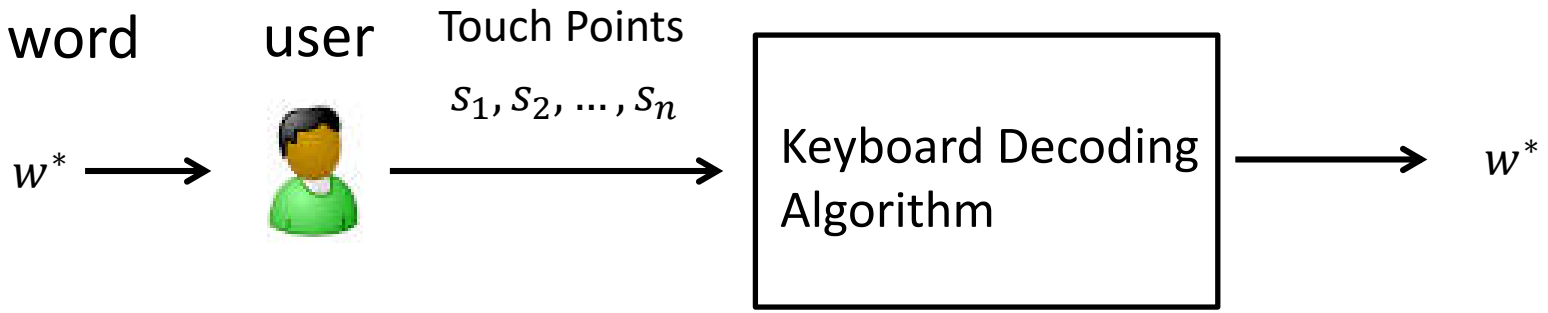


Assume *w* consists of *n* letters c_1 , c_2 , …, c_n

$$P(s_1, s_2, \dots, s_n|w\ ) = P(s_1, s_2, \dots, s_n|c_1, c_2, \dots, c_n\ )$$
$$= P(s_1|c_1)P(s_2|c_2) \dots P(s_n|c_n)$$

$$P(s_i|c_i) = P\left(s_i\middle|\mu, \sigma^2\right) = \frac{1}{(2\pi\sigma^2)^{1/2}} exp\{-\frac{1}{2\sigma^2}(s-\mu)^2\}$$

Principles of Smart Touch Keyboard



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$P(w)$: probability from language model

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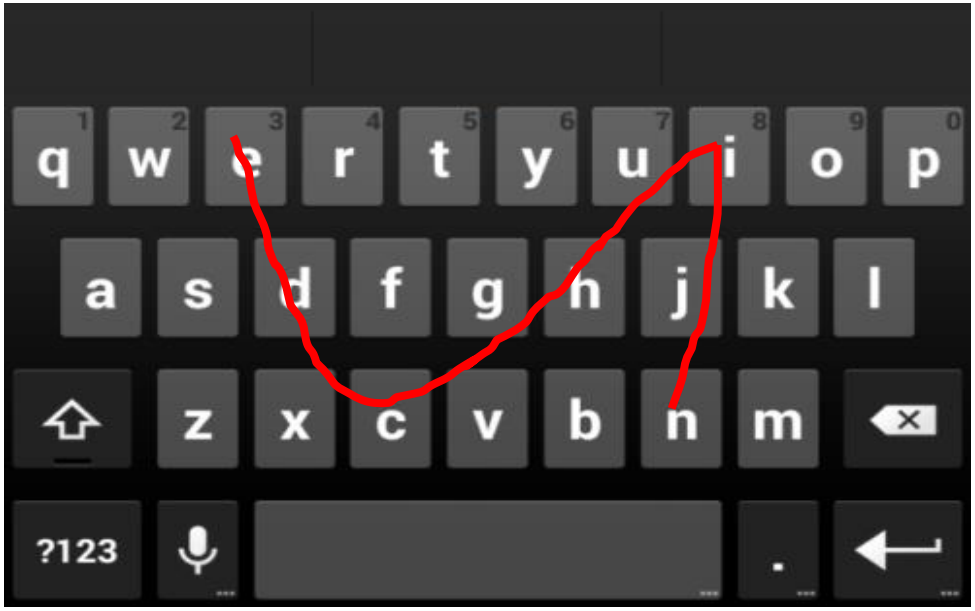
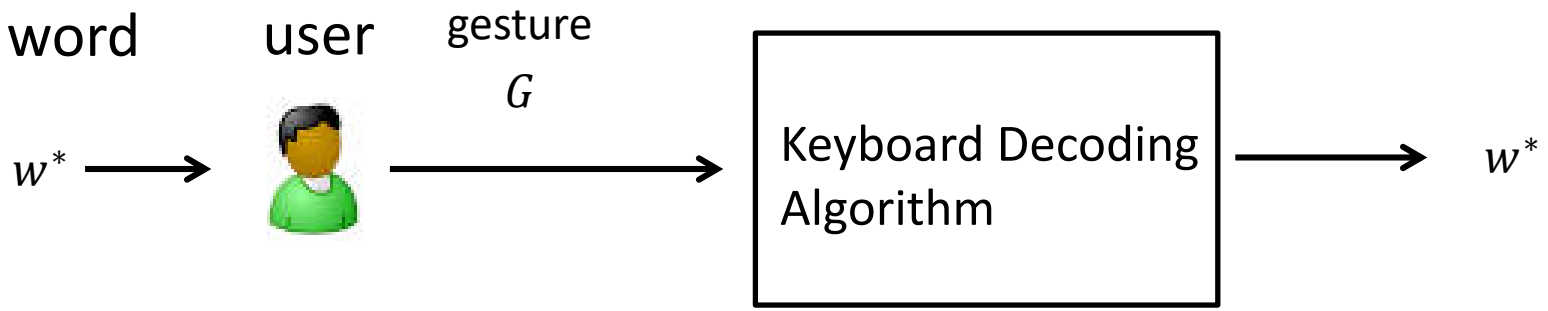
Gesture Keyboard

Entering *nice*



Gesture Decoder



$$W^* = \underset{w}{\operatorname{argmax}} P(W|G) = \underset{w}{\operatorname{argmax}} \frac{P(G|W)P(W)}{P(G)}$$

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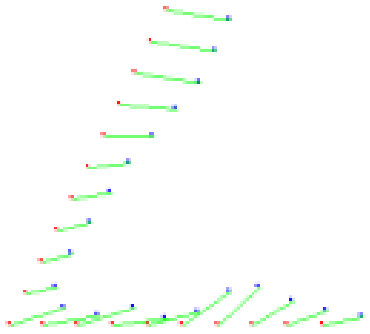
How to calculate $P(G|W)$?

Shumin Zhai and Per Ola Kristensson. 2012. The word-gesture keyboard: reimagining keyboard interaction. Commun. ACM 55, 9 (September 2012),

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.

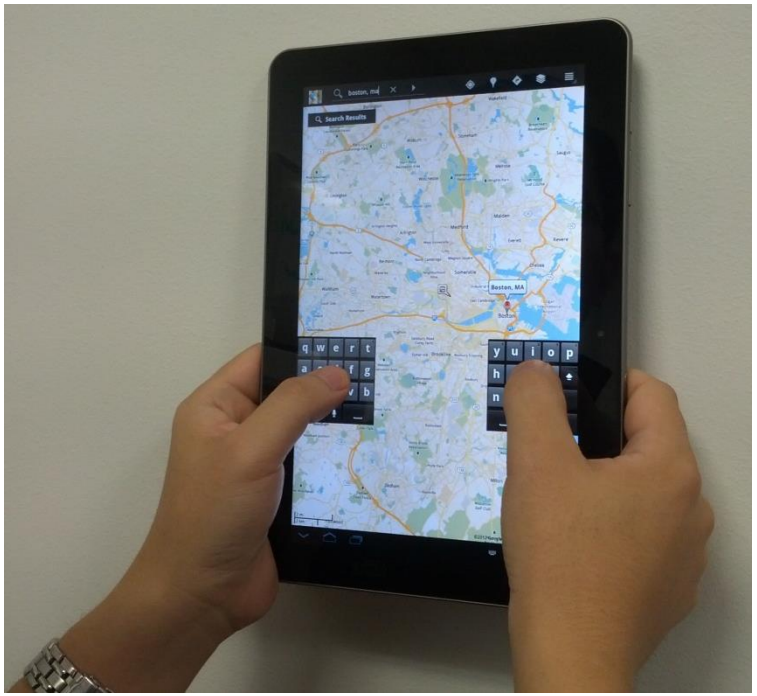
Gesture Keyboard

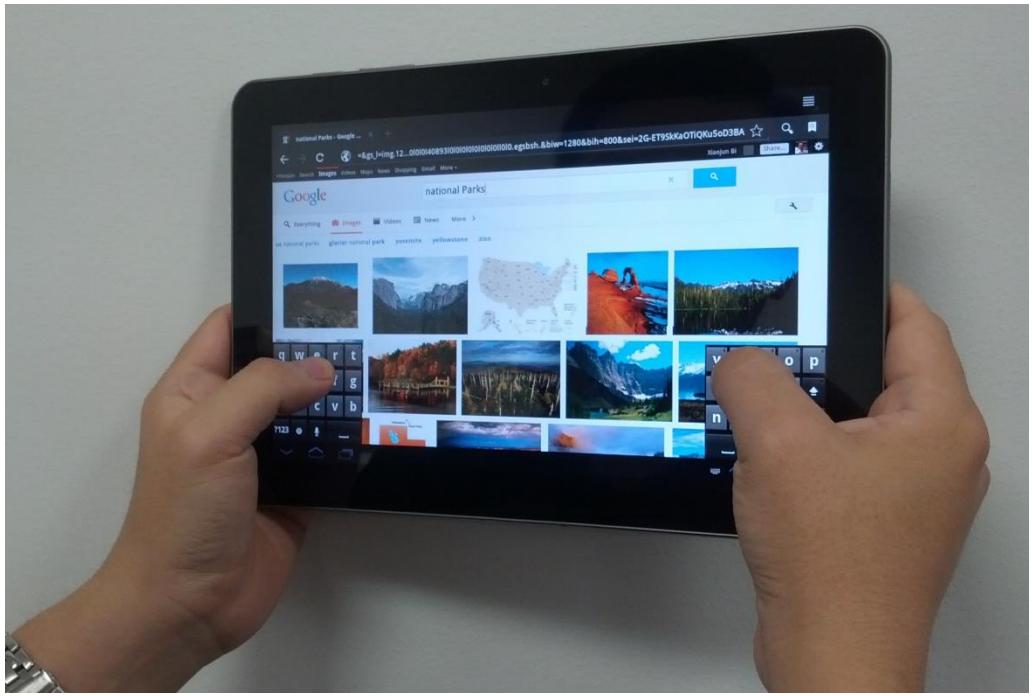
ShapeWriter

Android

Swype

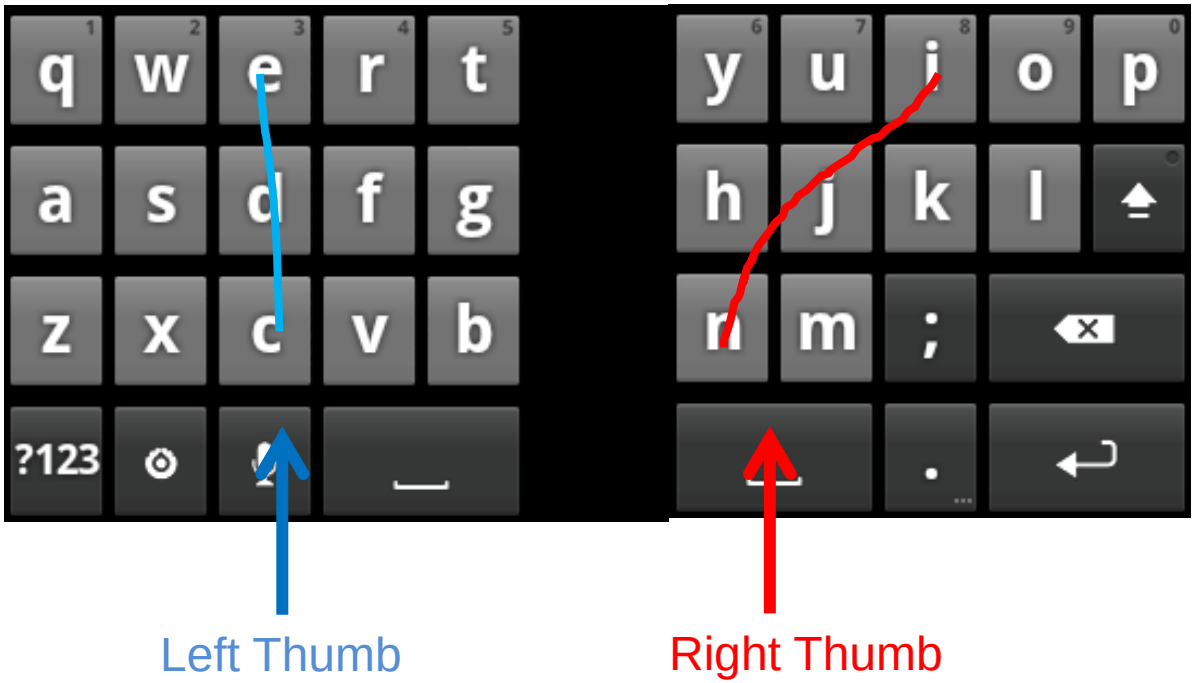
TouchPal


Search Results
Boston, MA


Google
national Parks

Bimanual Gesture Typing

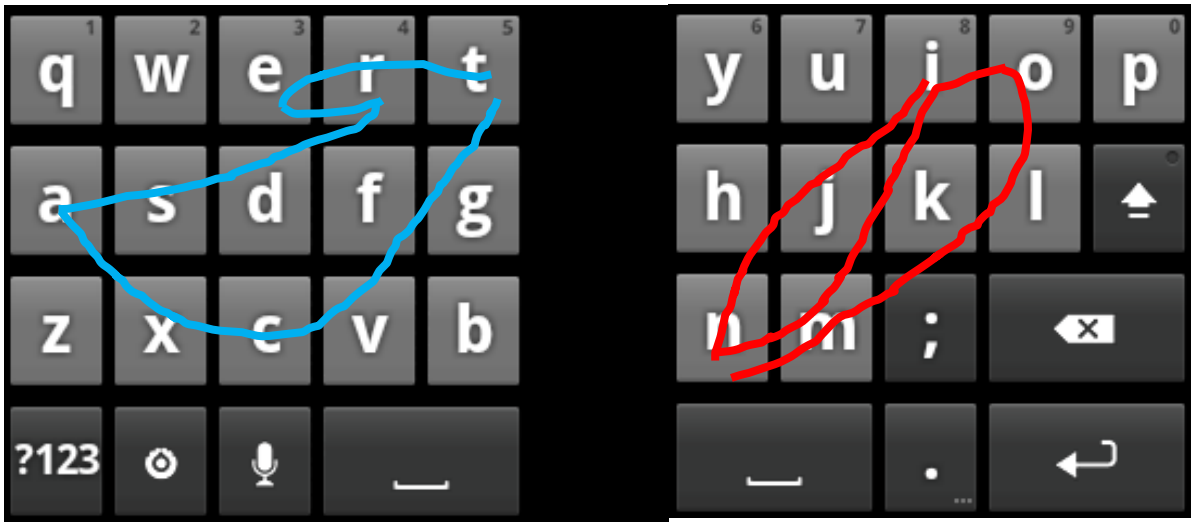
Entering *nice*



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

Bimanual Gesture Typing

Entering *interaction*



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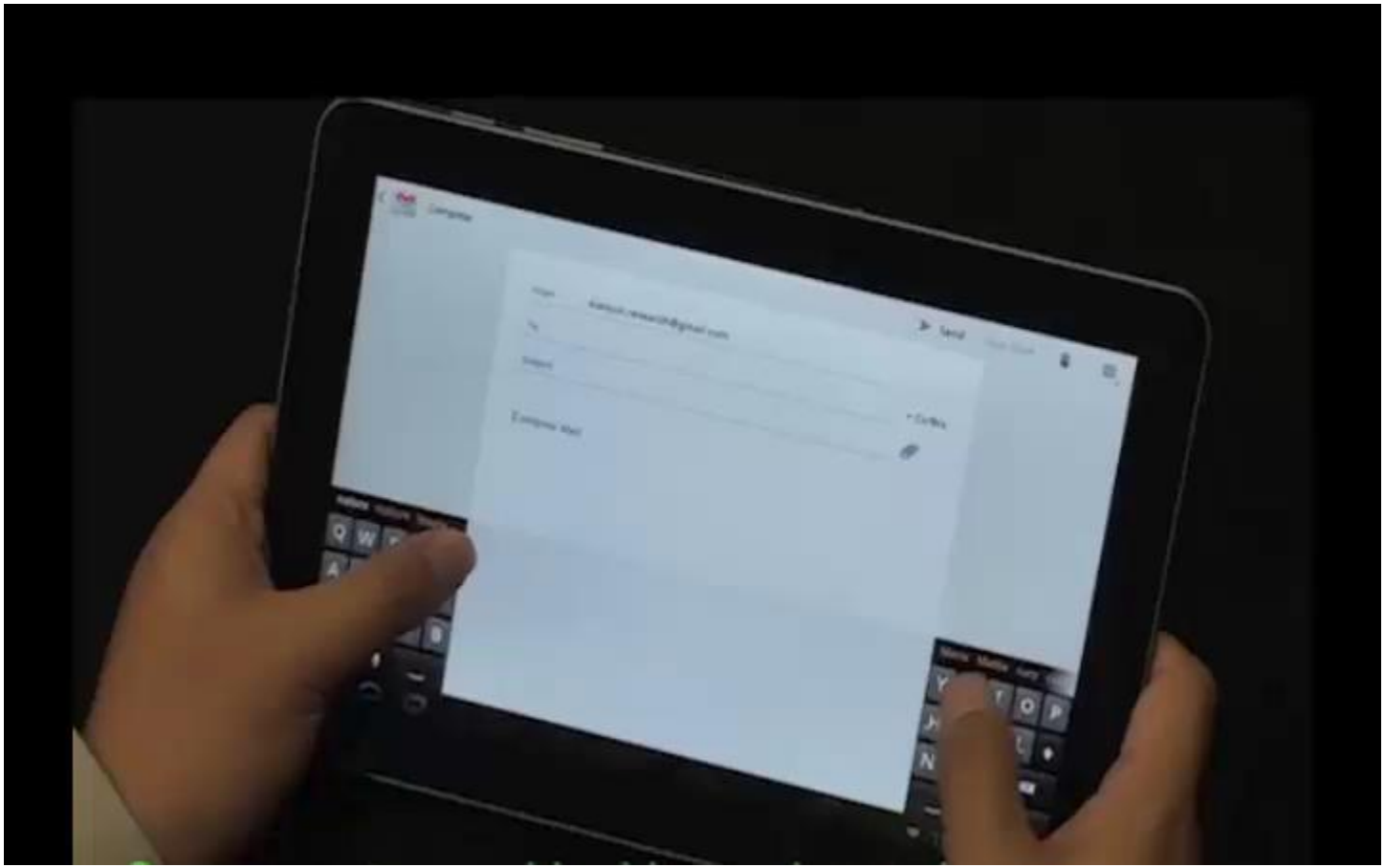

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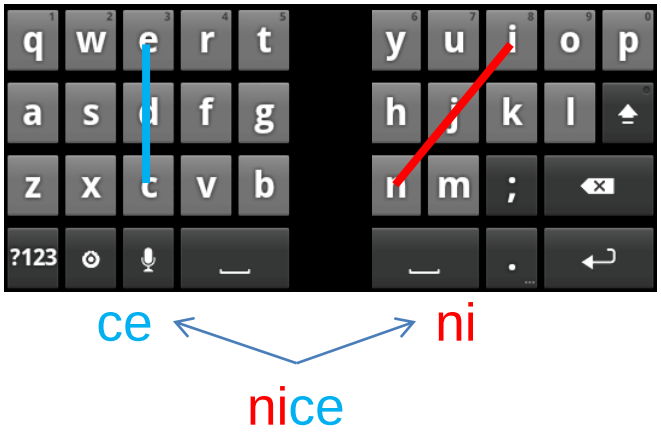
Perfect Templates



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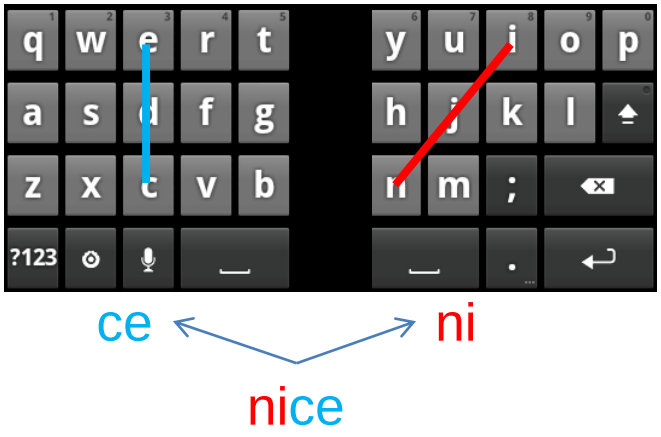

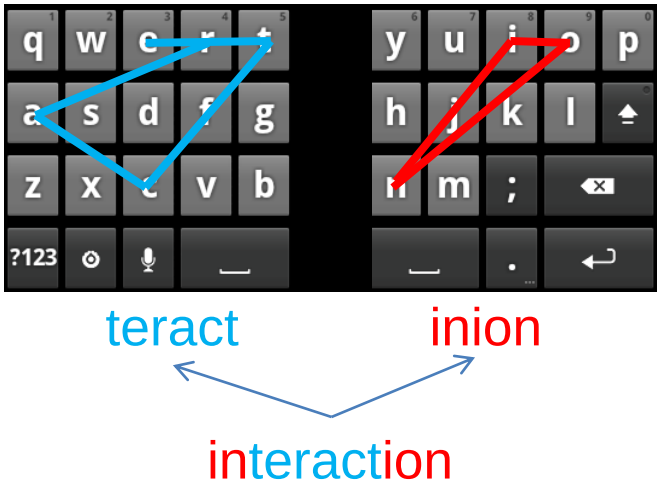

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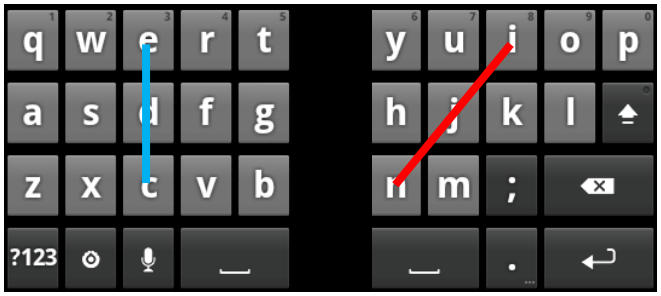

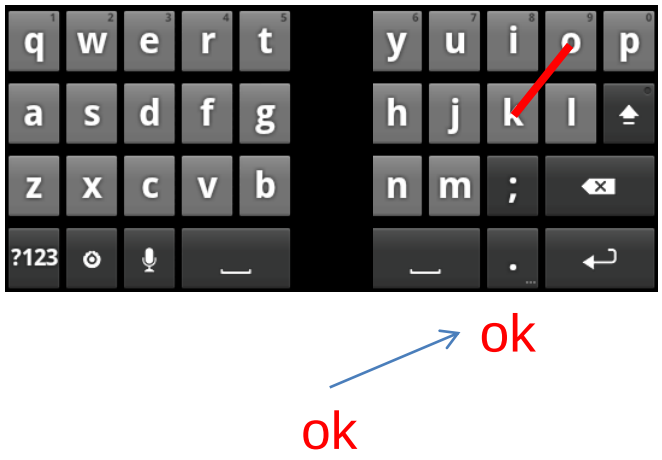

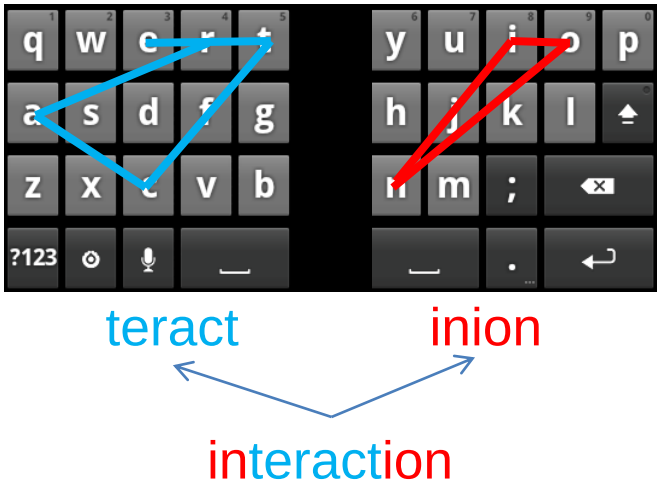

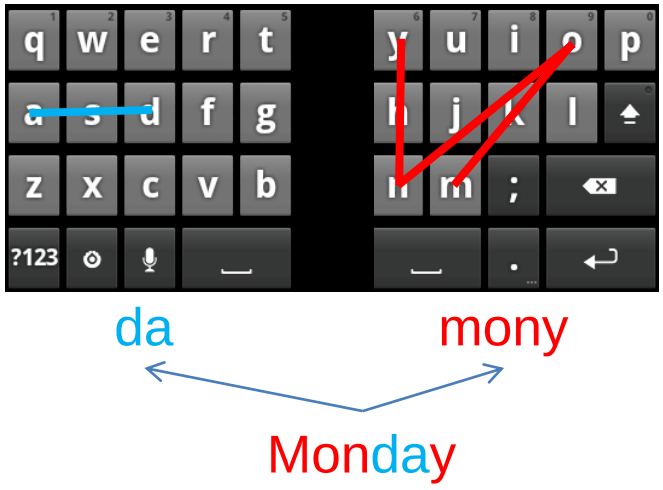

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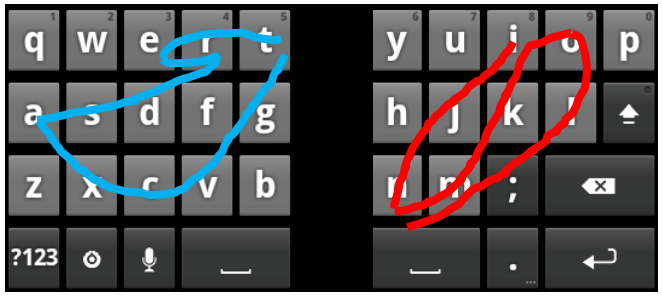
Bimanual Gesture Recognition



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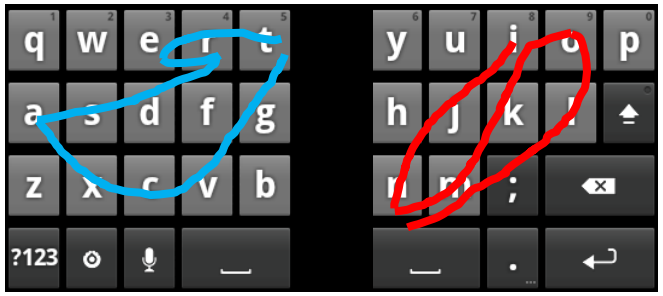
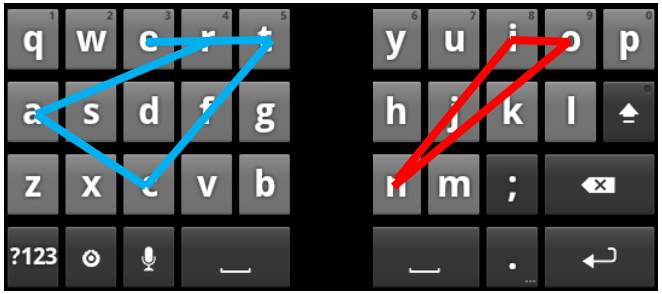
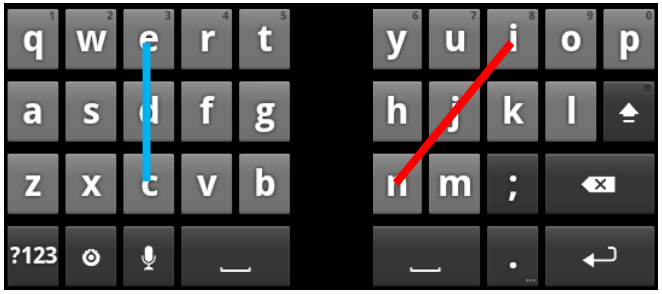


Best Match



interaction



nice

...

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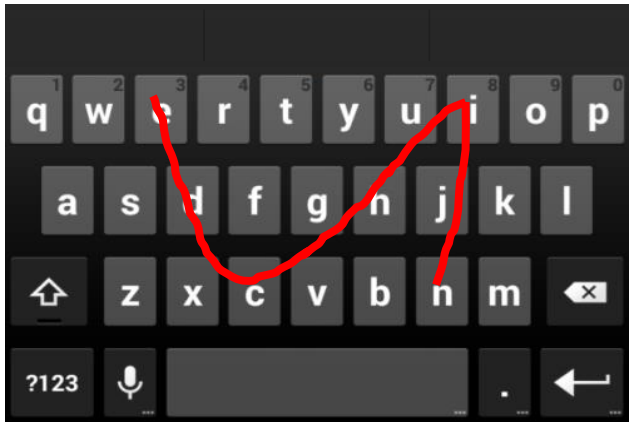
Entering *nice*

Unimanual Gesture



Bimanual Gesture

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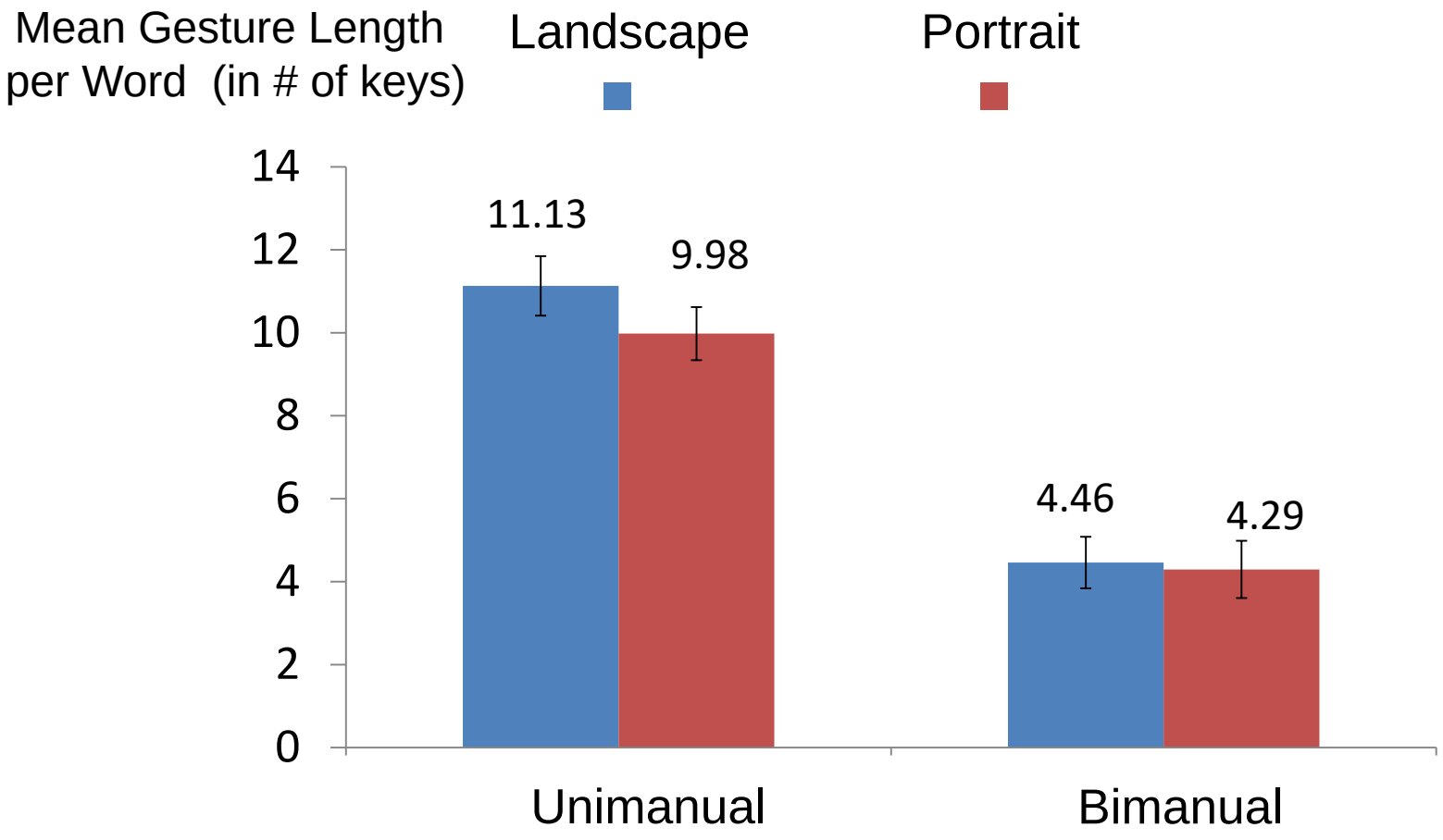
Finger Travel Distance of Unimaual and Bimanual Gesture Typing



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Android Keyboard

From www.androidpolice.com