2. Mobile and Ubiquitous User Interfaces

2.1 Mobile Computing

2.2 Design Guidelines for Mobile Devices

2.3 Input and Output on Mobile Devices

2.4 System Architectures for Mobile Devices

2.5 Example Applications

2.6 HCI and Ubiquitous Computing

Input Technologies for Mobile Devices

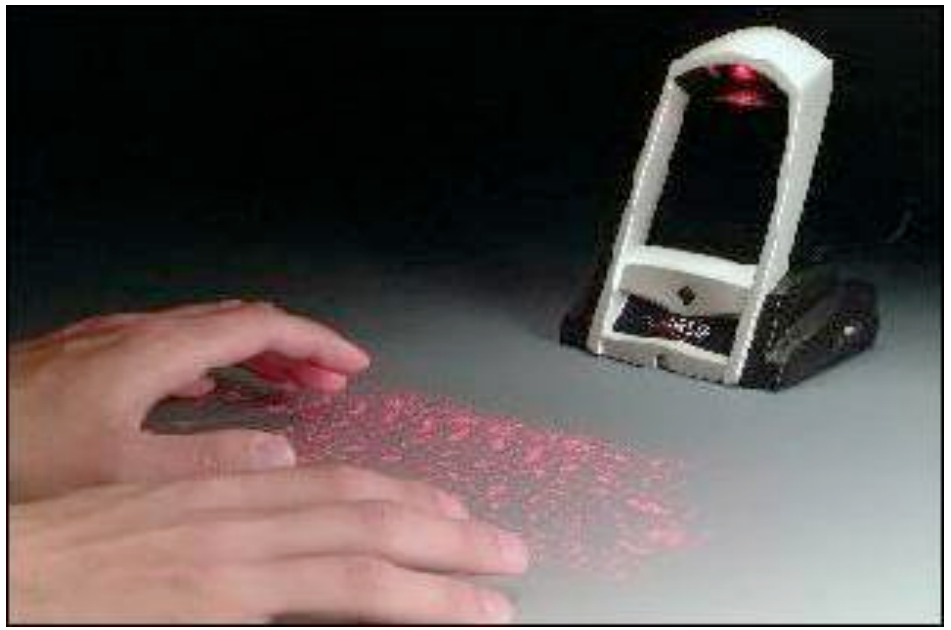
- Soft Keyboards
- Screen Keyboards

Input Technologies for Mobile Devices

Keyboards

Input Technologies for Mobile Devices

- Virtual Keyboards
- Projection Keyboards



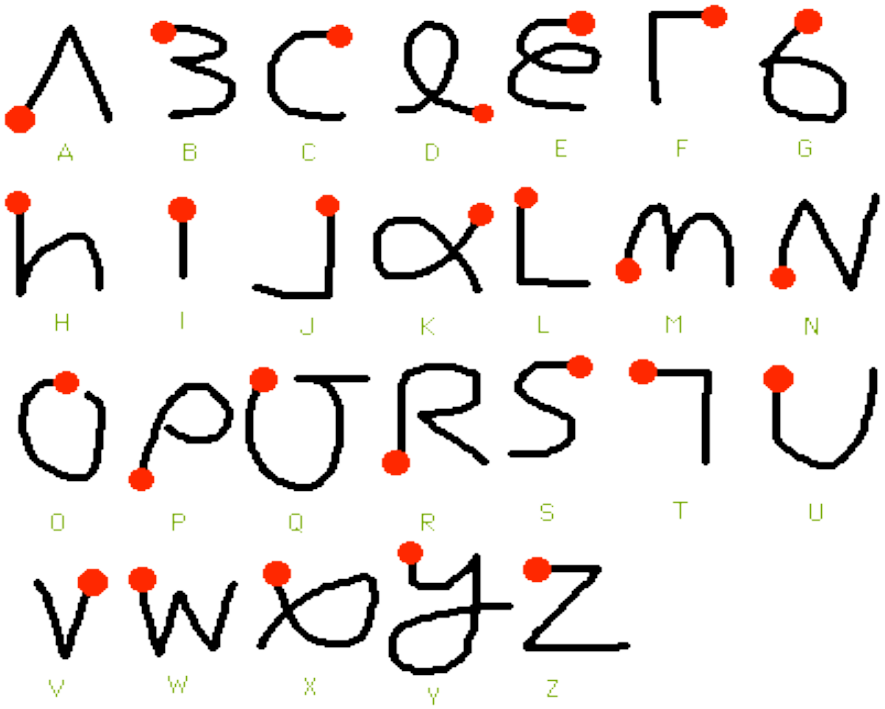
http://www.alpern.org/weblog/stories/2003/01/09/projectionKeyboards.html

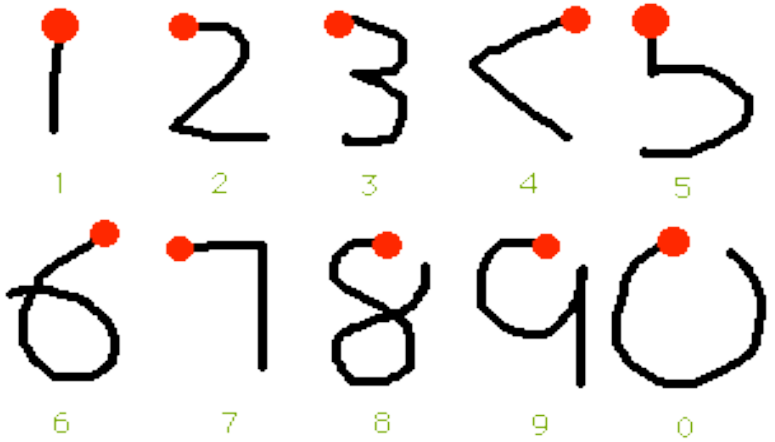
Unistroke

- Explored in the PARCTab Experiment
- Each letter is written in a single stroke
- Lifting the pen indicates a new letter
- Solves the separation problem

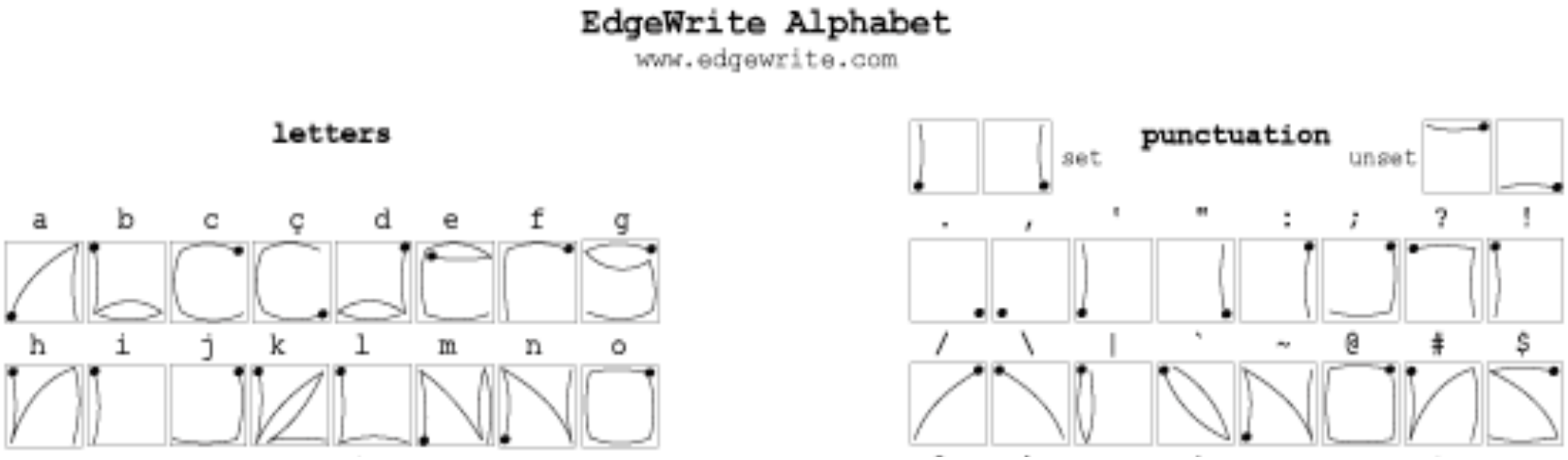
http://sandbox.parc.com/parctab/csl9501/paper.html

Graffiti
Unistroke used in PalmOS





EdgeWrite



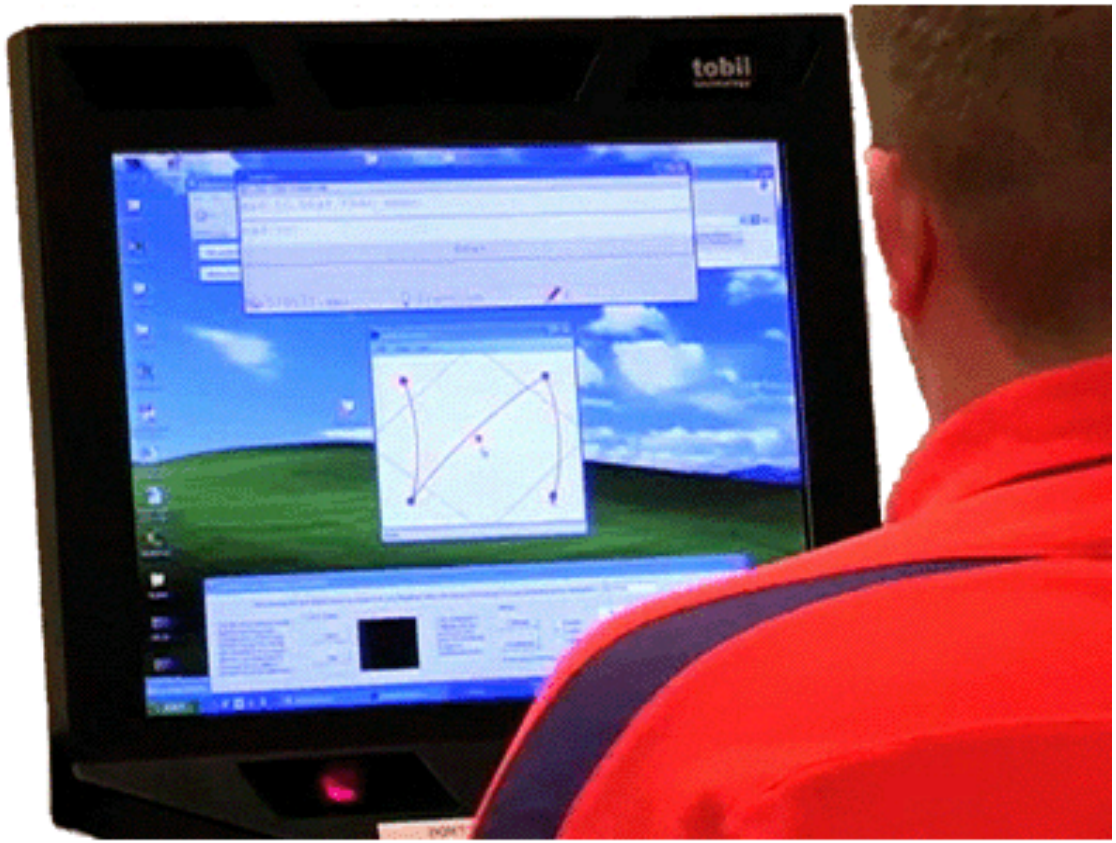
- http://depts.washington.edu/ewrite/

EdgeWrite for Different Modalities

EyeWrite *(new!)*

EyeWrite is the first letter-like text entry method that uses eye gestures. EyeWrite takes far less screen real estate than most on-screen keyboards, and is more resilient to eye-tracker jitter due to having large corner targets.

Although EyeWrite is designed to work with a Tobii eye-tracker, it can be simulated with a mouse or trackball pointing device.



http://depts.washington.edu/ewrite/eyewrite.html

Mobile Phone Text Input

- Fewer keys than letters!
- Approaches
  - Multitap
  - Dictionary based disambiguation
  - Prefix-based disambiguation
  - Multiple simultaneous key presses
- Metrics
  - Complexity
  - Visibility
  - Keystrokes per character (KSPC)

Multi-Tap

- A key has more than one letter assigned
- Pressing the key once gives the first, twice the second, and so on
- After a period of time or when changing to another button the letter is selected
- Advantage
  - You can see what you write
  - Easy to understand
- Problem
  - High number of average key presses per letter
- About 2 KSPC

Predictive Text Input
Dictionary based disambiguation

- Example T9, iTap, (SureTap)
- Input is compared to a dictionary
- Input is matched to existing words
- If non-ambiguous a single word is offered
- If multiple words are possible the one with the highest probability is offered and a mechanism to select the others
- Advantage
  - Very fast input mechanism for words in the dictionary
- Problems
  - Slow for words that are not in the dictionary
  - The word that is actually typed is not always visible
- For words in the dictionary KSPC is close to 1

Basis for predictive input

- Word frequency
- Letter frequency
- Frequency of letter groups
- Frequency of word groups

- http://deafandblind.com/word_frequency.htm
- http://www.fortunecity.com/skyscraper/coding/379/lesson1.htm

Prefix-based disambiguation

- EATONI
  - LetterWise
  - WordWise
  - http://www.eatoni.com/

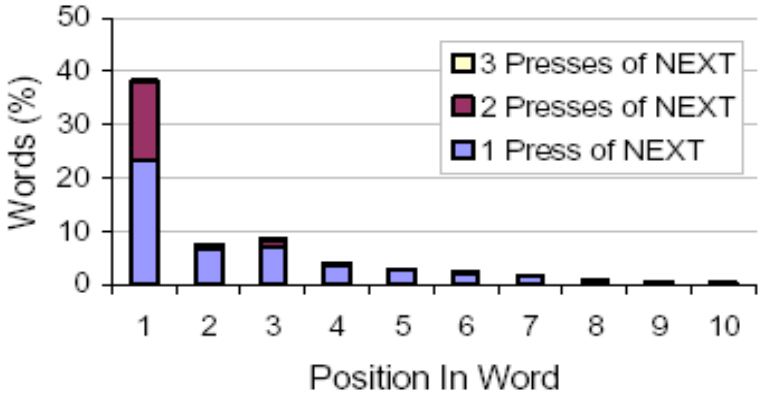


Figure 2. Press of NEXT vs. letter position in word

- Language is analyzed and probabilities for letter sequences is calculated
  - P(“a“)=… P(“b“)=… P(“y“)=… P(“z“)=…
  - P(“aa“)=… P(“ab“)=… P(“zy“)=… P(“zz“)=…
  - P(“aaa“)=… P(“aab“)=… P(“zzy“)=… P(“zzz“)=…
- Probabilities are used to chose next character that is displayed

I. Scott MacKenzie, Hedy Kober, Derek Smith, Terry Jones and Eugene Skepner LetterWise: Prefix-based Disambiguation for Mobile Text Input in the proceedings of the 14th Annual ACM Symposium on User Interface Software and Technology (UIST), November 2001, Orlando, Florida.

- See also: http://www.speedscript.biz/

Fasttap

Fastap's keypad may look small, but the buttons work and feel a lot like the keys on your computer keyboard.

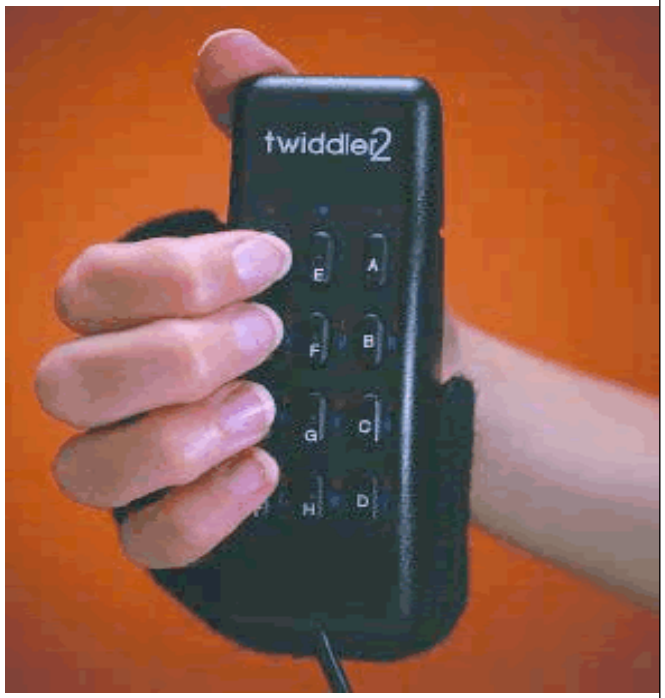
Letters are raised and number keys are lowered so that your finger will probably touch letter keys when you strike a number - but that's okay.

That's how Fastap technology works, you don't need to be careful!

- Different keys for numbers and letters
- Different height

http://www.ideal-group.org/demonstrations/fasttap.htm
http://www.phonescoop.com/articles/video_fastap/

Input Technologies for Mobile Devices



- Chord Keyboard
- One-handed Keyboards
- Example Twiddler
  - Combines keyboard and Mouse
  - Keypad designed for "chord" keying:

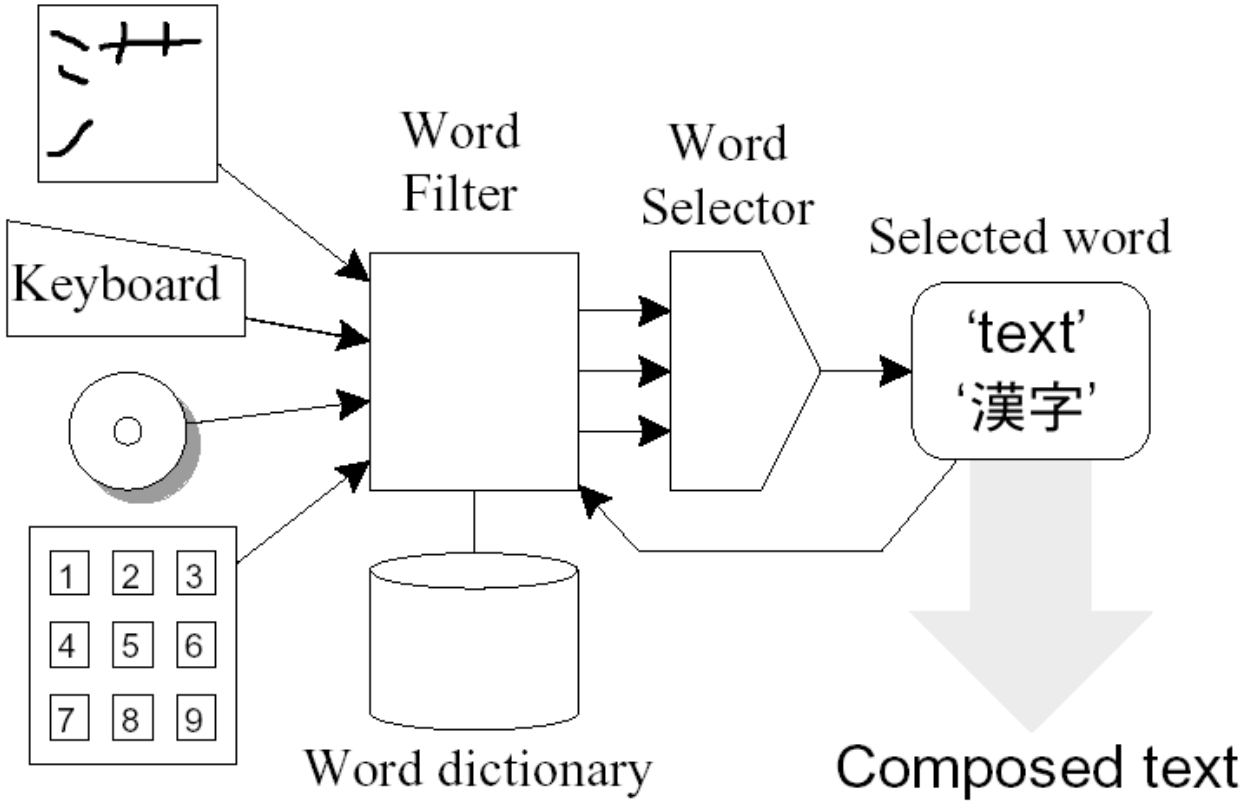
    This means you press one or more keys at a time. Each key combination generates a unique character or command.
  - 12 finger keys and 6 thumb keys, the Twiddler can emulate the 101 keys on the standard keyboard

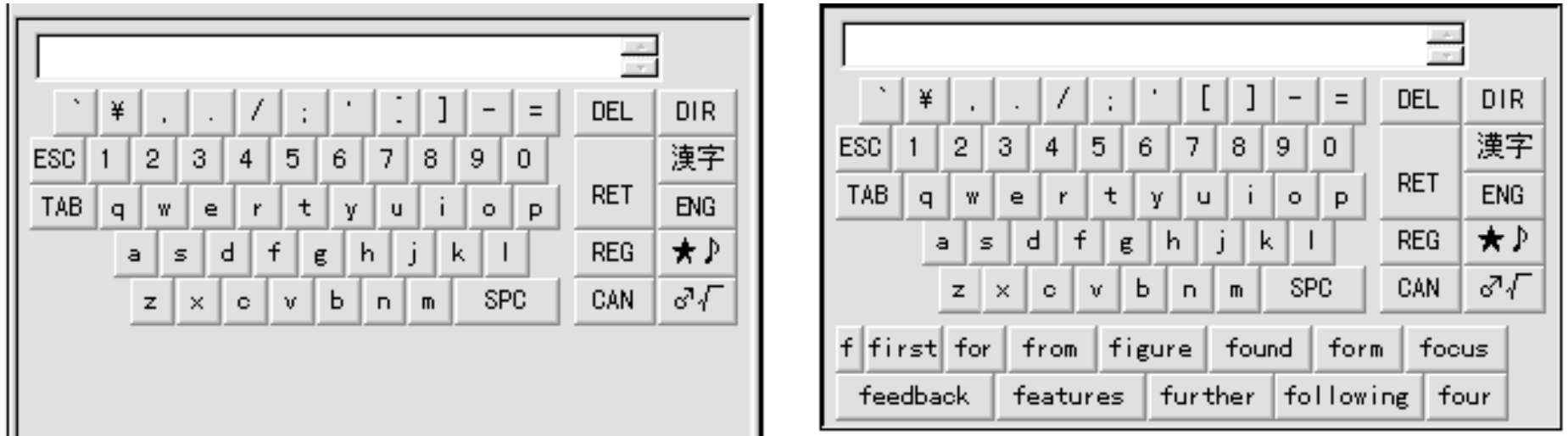
Multiple Simultaneous Key Presses

- Frogpad
  - Mini-keyboard
  - Static arrangement of letters based on frequency in the language text corpus
  - Pressing two keys provides the second option
  - http://www.frogpad.com/

Predictive Input

- Example: POBox - An Efficient Text Input Method for Handheld and Ubiquitous Computers. Toshiyuki Masui. HUC99
  http://www.csl.sony.co.jp/person/masui/papers/HUC99/HUC99.pdf
- Predictive cOmposition Based On eXample

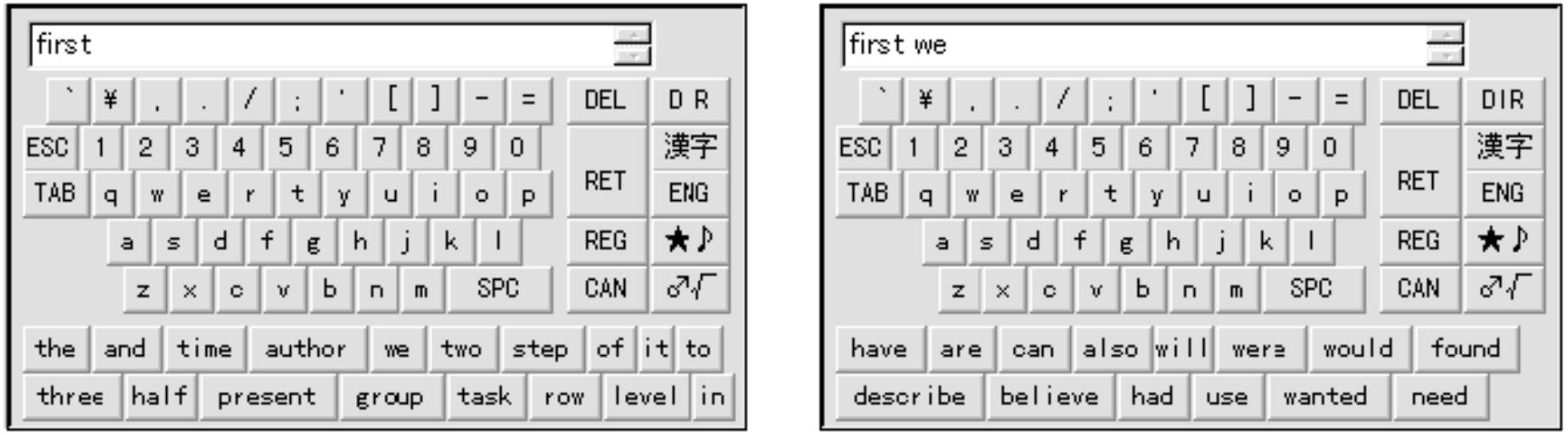




(a) Initial Display

(b) After tapping the ''F'' key

Fig. 4. Pen-based POBox.



(a) After selecting '**first**'

(b) After selecting '**we**'

Fig. 5. After selecting "**first**" and "**we**".