Wearable Computing

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WS 05/06

Text Input

- Key Input
- Pen Input
- Voice Input

Pointing, Selection, Gesture

Output Devices

- Visual Output
- Audio Output
- Tactile Output

Requirements for Wearables

- Wearable computing: support primary task
- Use computer while doing other things
- Goal: hands-free interaction
- Hands-free definition: interaction while using hands for primary task.
- Data-glove is sometimes considered “hands-free”

Text Input

- Typing
- Word Selection
- Pen Input
- Voice Input

Key Input

- Input Keys
- Command Keys (Backspace, Del, Cursor, Enter,...)
- Modifier Keys (Shift, Alt, Ctrl, Command)
- Keyboard Mode (Shift Lock, Num Lock)

Standard Keyboards

- Full-size (102-105 Keys, localized): >50 wpm, trained users much faster
- built-in (Notebooks, PDAs, Push Clients, . . .)
- wrist-mounted
- flexible

small PS2 keyboard

Image from H. Kenn

xybernaut arm keyboard

Image from H. Kenn

Indestructibe Keyboard

Image from H. Kenn

OQO PDA w. keyboard

Image from H. Kenn

SK65 keyboard

Image from H. Kenn

Wireless Standard Keyboards

- proprietary Infrared (Multimedia Remote Control)
- proprietary RF (“Wireless Desktop”)
- Bluetooth (HID-Profile)
- GSM Phones with HID Profile (e.g. K600i)

Stowaway Bluetooth keyboard

Image from H. Kenn

Custom Keyboards

- wired
- wireless
- textile-integrated

titv textile keyboard

Image from H. Kenn

Chording Keyboards

- Idea: Multiple Keys pressed together create a single key event
- Result: Less keys
- one-hand blind typing (for trained users)
- Training needed, Impractical for untrained users

Twiddler

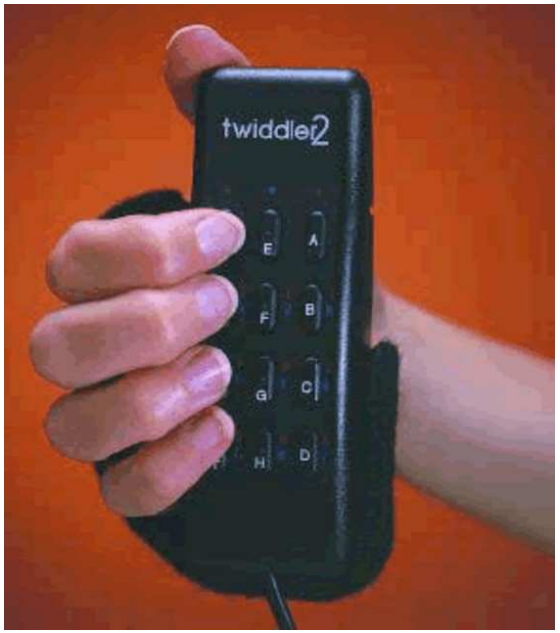

Image from handkey.com website

Frogpad

Image from H. Kenn

Phone Keyboard

Image from H. Kenn

Multitap

- Origin: American “vanity number” letter codes
- Problem: Multiple letters on keys
- Solution: Select letter by tapping the key multiple times
- Timeout needed, Alternative: two-key (letter + index) or timeout key
- Maximum speed: 25-27wpm (w. timeout key), untrained users about 7 wpm

T9

- Predicting text input method
- invented by tegic communications, now owned by AOL
- Idea: type vanity keys without selecting the letter, use a dictionary to find a list of possible words
- Language-specific dictionaries, input language must be configured
- Shorthands for common words
- Timeout, selection keys and/or enter key needed
- Speed up to 46 wpm

Morse Key

Image from H. Kenn

Morse Code

- Single Key, four symbols (dash, dot, short break, long break)
- Training required
- short codes (Q-code, Z-Code)
- 1939 speed record: 75.2 wpm (McElroy)
- still used in HAM radio
- QRQ Clubs (>40 wpm)

Pen Input

- Input devices: touch screen, tracking pen
- Touch Screen: Pressure sensitive (Palm) vs special pen (OQO)
- graphic only: UPS “electronic signature”
- tracking pen: optical (Anoto pen), motion sensor

Logitech IO Anoto Pen

Image from logitech.com website

Handwriting Recognition

- Hard problem
- Block Letters: easier
- smooth handwriting: tough
- Various standard products: PocketPC, Windows XP Tablet PC Edition

Graffiti

- As handwriting recognition is a hard problem, use a simplified set of strokes to ease recognition
- Palm Graffiti: single stroke letters
- Palm Graffiti2: multiple stroke letters, more similar to block letters

Graffiti

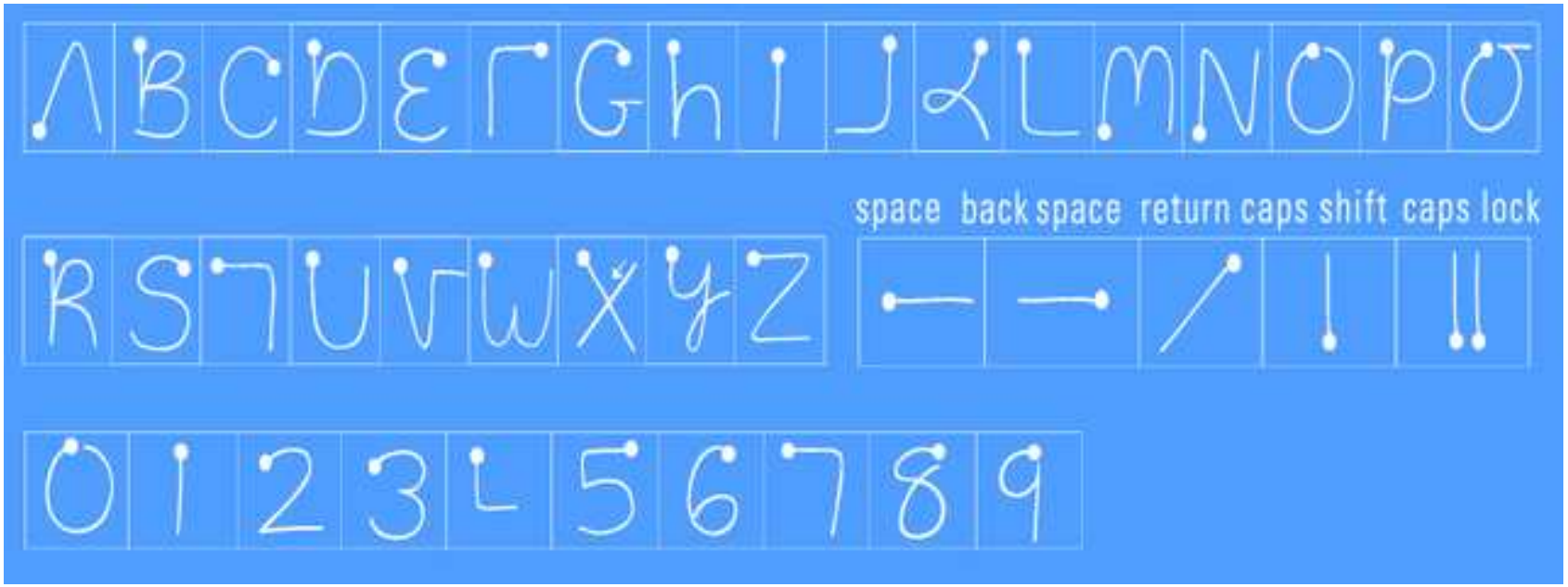

Image from palm.com website

Graffiti 2

Image from palm.com website

Voice Input

- Goal: Computer “understands” “spoken language”
- General voice recognition unsolved, speech ambiguity → strong AI problem
- Several approaches: Speaker-dependent vs. Speaker-independent, large vs. small dictionary

Input Devices

- Microphones
- Problem: Signal/Noise ratio
- Solution 1: Move microphone closer
- Headsets, invisio
- Solution 2: Ignore noise
- directional microphones
- Multiple microphones, beamforming (used in speakerphones)

Command based

- Problem: when is information relevant for the computer
- Solution: Magic Word
- Scifi example: Star Treck: Commands start with “computer!”
- Commercial implementations: Sony Ericsson phones voice dial
- Alternative: Push-to-talk

Few words, speaker independent

- Typical application: automated phone services
- Typical words: Yes, No, numbers
- Sometimes larger dictionaries: Automatic timetable service
- Try it yourself: Deutsche Bahn Toll-free 0800 1 50 70 90

Many Words, few speakers

- Training required
- uses machine learning and dictionaries
- specialized professional dictionaries: medicine, law
- Example: IBM ViaVoice

Pointing, Selection, Gesture

- Complementing keyboard
- Often more efficient
- In many application, a text entry system is still needed.

WIMP Methaphor

- Windows, Icons, Menus, Pointer
- Standard for desktop
- Comparable interfaces exist for PDA: Pen controls Pointer
- not really suited for wearable use

Finger Trackball

Image from H. Kenn

Twiddler Trackpoint

Image from H. Kenn

Ultrasound 3d Mice

- Uses body-mounted ultrasound transmitters and receivers
- Tracks hand motion in 3D

Image Processing-based

- Using a camera to recognize gestures
- hard problem: find hand, track hand, recognize gesture
- even harder in wearable environment

Gesture

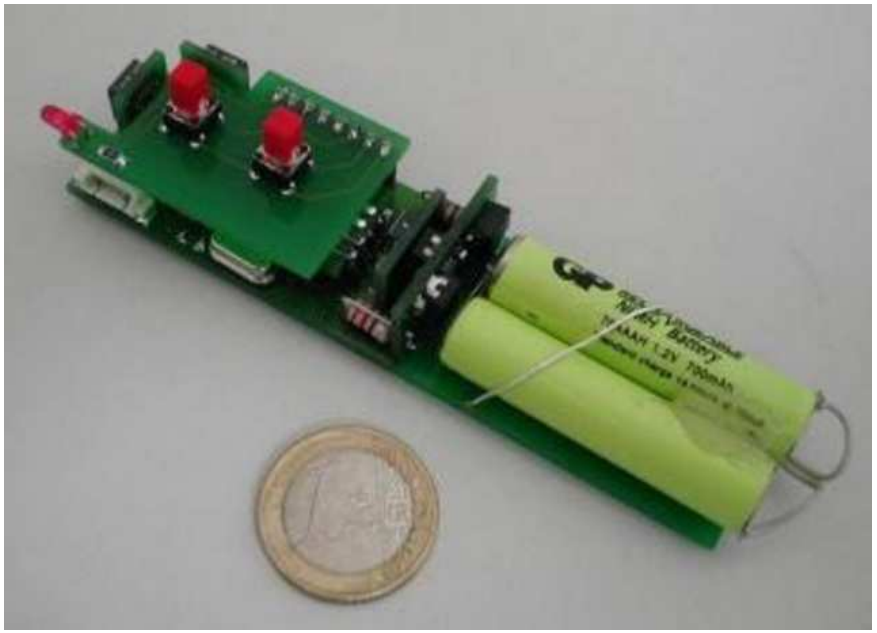

Image from beecon.de website

Glove

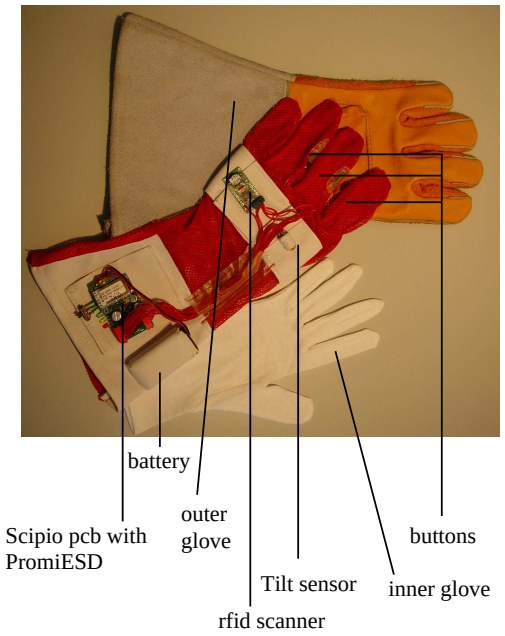

Image from H. Kenn

Summary

- Text Entry: Keyboards, Chording, Voice
- Pointing, Selection, Gesture