Chapter 1

Wearable Input Devices

Recap

Slide Output Devices:

- Visual Output
- Audio Output
- Tactile Output

Slide 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”

1.1 Text Input

Slide Text Input:

- Typing
- Word Selection
- Pen Input
- Voice Input

1.1.1 Key Input

Slide Key Input:

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

Slide Standard Keyboards:

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

Slide small PS2 keyboard:

Image from H. Kenn

Slide xybernaut arm keyboard:

Image from H. Kenn

Slide Indestructibe Keyboard:

Image from H. Kenn

Slide OQO PDA w. keyboard:

Image from H. Kenn

Slide SK65 keyboard:

Image from H. Kenn

Slide Wireless Standard Keyboards:

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

Slide Stowaway Bluetooth keyboard:

Image from H. Kenn

Slide Custom Keyboards:

- wired
- wireless
- textile-integrated

Slide titv textile keyboard:

Image from H. Kenn

Slide 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

Slide Twiddler:

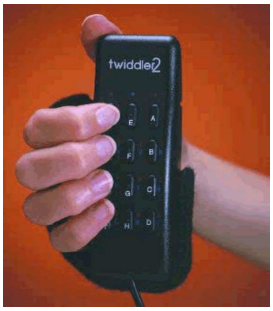

Image from handkey.com website

Slide Frogpad:

Image from H. Kenn

Slide Phone Keyboard:

Image from H. Kenn

Slide 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

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Slide 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

Slide Morse Key:

Image from H. Kenn

Slide 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)

1.1.2 Pen Input

Slide 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

Slide Logitech IO Anoto Pen:

Image from logitech.com website

Slide Handwriting Recognition:

- Hard problem

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

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Slide 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

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Slide Graffiti:

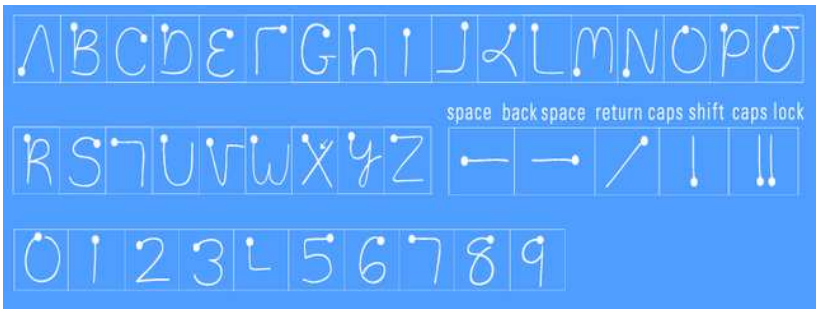

Image from palm.com website

Slide Graffiti 2:

Image from palm.com website

1.1.3 Voice Input

Slide 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

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Slide 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)

Slide 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

Slide 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

Slide Many Words, few speakers:

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

1.2 Pointing, Selection, Gesture

Slide Pointing, Selection, Gesture:

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

Slide WIMP Methaphor:

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

Slide Finger Trackball:

Image from H. Kenn

Slide Twiddler Trackpoint:

Image from H. Kenn

Slide Ultrasound 3d Mice:

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

Slide Image Processing-based:

- Using a camera to recognize gestures
- hard problem: find hand, track hand, recognize gesture
- even harder in wearable environment
- Implementation: Fingermouse from ETH Zuerich (Patrick de la Hamette)

Slide Finger Mouse:

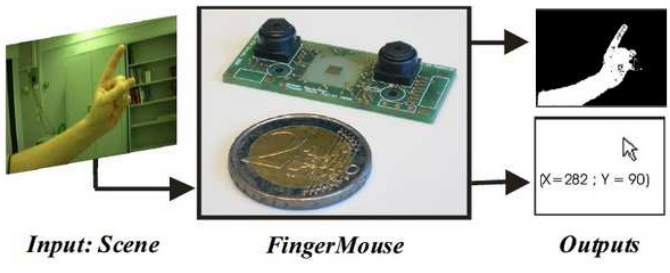

Image from P. de la Hamette, ISWC2006 Poster

Slide Finger Mouse:

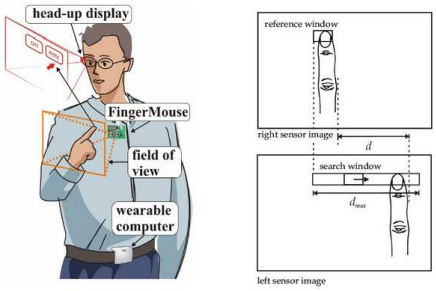

Image from P. de la Hamette, ISWC2006 Poster

Slide Gesture:

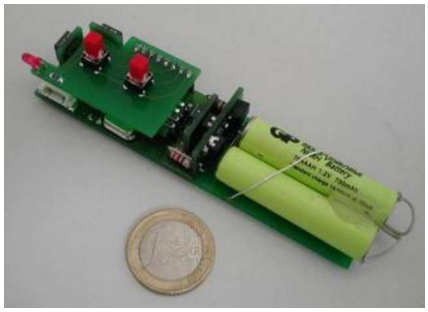

Image from beecon.de website

Slide Glove:

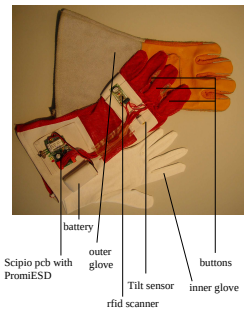

Image from H. Kenn

Slide WInspect Glove:

Image from H. Kenn

Slide GestureBand:

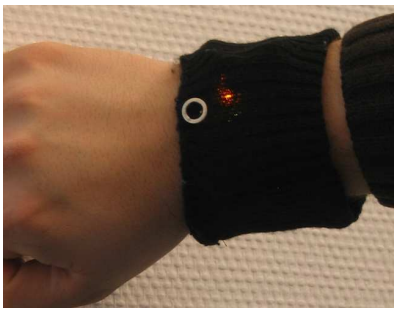

Image from H. Kenn

Summary

Slide Summary:

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