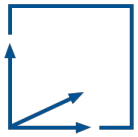
Module IN 2018

3D User Interfaces
- Dreidimensionale Nutzerschnittstellen -

Prof. Gudrun Klinker



Interaction Techniques: Symbolic Input

SS 2023

Agenda

1. Overview
2. Symbolic Input Tasks
3. Symbolic Input Techniques
4. Design Guidelines

1. Overview

1.1 Motivation

- Symbolic input (esp. text) is essential in desktop environments
- Thus far, it has been rather ignored in 3D UI

1.2 Scenarios of Use

- Design annotation
- Filename entry
- Labelling
- Precise object manipulation
- Parameter setting
- Communication between users
- Markup

1.3 Distinctive Features of Symbolic Input in 3D UIs

- Inherent differences between 2D and 3D UIs:
  - Users are often standing
  - Users may move physically around
  - There is usually no surface on which to place a keyboard
  - It may be difficult or impossible to see a keyboard in low-light environments
- Workarounds: keyboard strapped to wrist or waist
- Symbolic input may be much less frequent in 3D UIs
- Length of use may be shorter
- Abundance of already existing mobile symbolic input systems (smartphone, tablet)

1.3 Distinctive Features of Symbolic Input in 3D UIs

Recent strong developments

- Ubiquitous use of (mobile) smartphones

- Large 3D display environments (CAVEs)
  → Head Mounted Displays (HMDs) (VR)
- VR vs. AR

Users see their real environment

Users see only the virtual environment

- Use of tracked controllers
  (soft keyboards + ray casting)

Consequences still under investigation

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2. Symbolic Input Tasks

- Alphanumeric input
  - Alphabetic, numeric and punctuation characters, spaces, accent marks
- Editing alphanumeric symbols
  - Insert, delete, specify a region, go to a position in the text
- Markup input
  - Use formatting styles: bold, italics, underline, fonts, sizes

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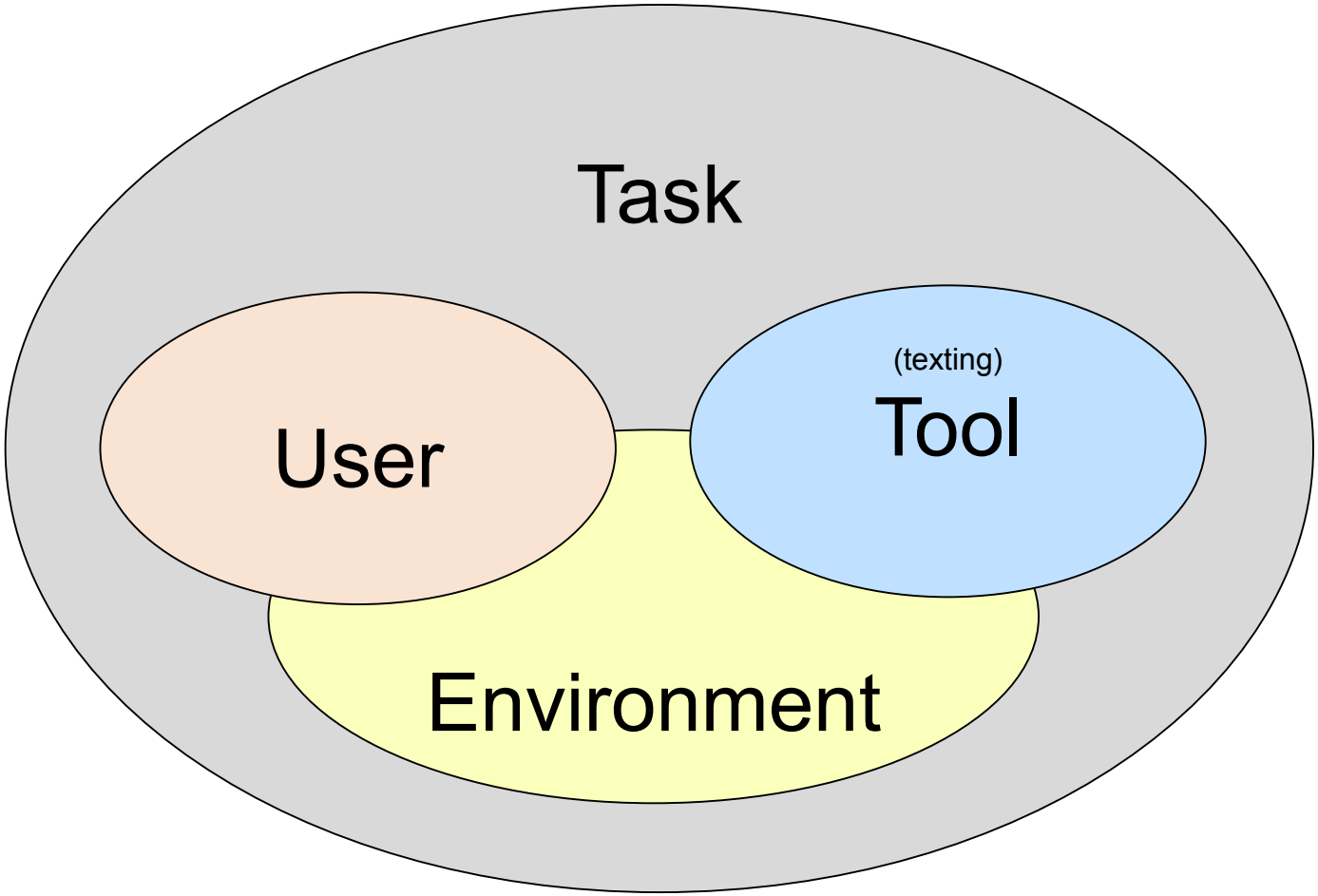
2. Symbolic Input Tasks
3. → Symbolic Input Techniques
4. Design Guidelines

3. Symbolic Input Techniques

3.1 General Issues (Overview)



3.1 General Issues (Overview)

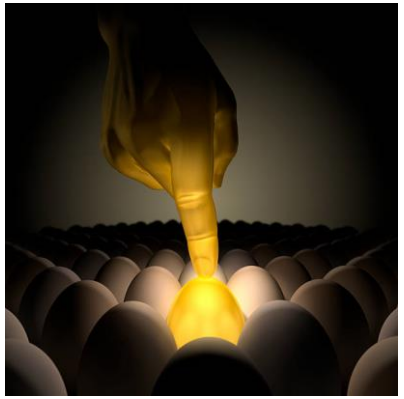
Task

- Frequency of text input
- Amount of text
- Level of system understanding (character regognition)
- Required input speed / user reaction time
- Primary vs. secondary task

3.1 General Issues (Overview)

User

- Involved body part(s)
  - 10 fingers (hand-relative motion)
  - hand (shoulder-relative motion)
  - <speech>
- Real-time perception of own action (blind typing, touch, …)
- Fatigue (physical, mental)
- Midas problem: ability to unclutch / interrupt?



Getty Images/iStock: Karl Dolenc/BeholdingEye

3.1 General Issues (Overview)

Tool

- Input support / motion constraints:
  - Required input gesture: select + acknowledge
  - Reference point(s) / ankers, DoFs
  - Accuracy & rate
- Feedback
  - Before typing (aiming phase)
  - When typing
  - After typing
- Visualization / animation of typing process
- Automatic letter suggestion, error correction

3.1 General Issues (Overview)

Environment (VR/AR setup)

- Physical view of surroundings + self (hand, fingers)
  - hidden (opaque HMD)
  - visible (transparent HMD, monitor/CAVE)
- Degree of mobility
- Available areas for physical support
  - Stationary or mobile?

3. Symbolic Input Techniques

3.1 General Issues (Overview)

→ 3.2 Keyboard-Based Techniques

3.3 Pen-Based Techniques

3.4 Gesture-Based Techniques

3.5 Speech-Based Techniques

3.2 Keyboard-Based Techniques

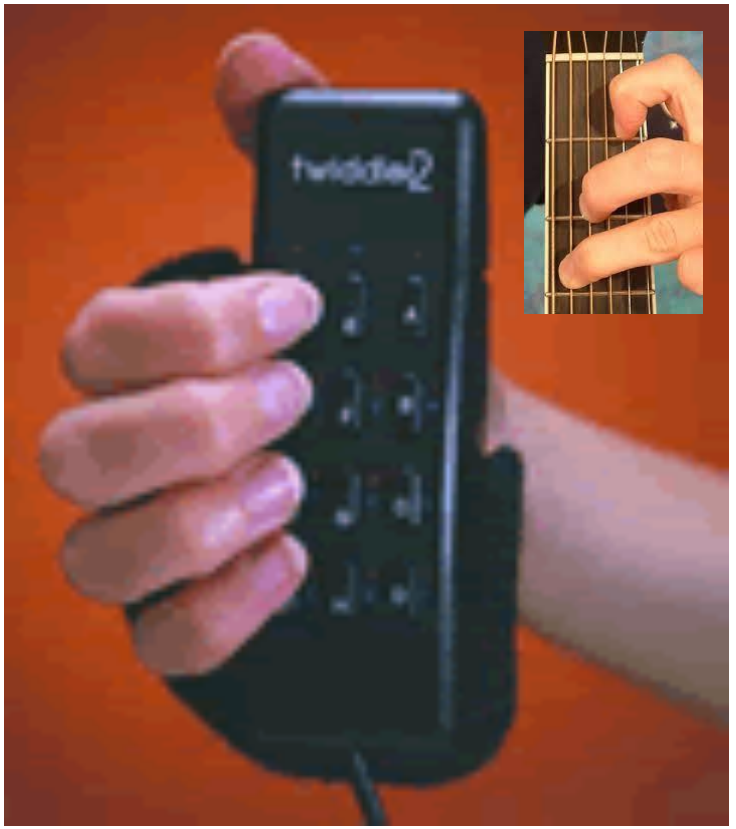
- Miniature keyboards (QWERTY)
  - Best results when miniature keyboard is strapped to the forearm of the non-dominant hand.



- Low key-count keyboards
  - Reduced number of physical keys (mobile phone)
  - T9 text input

3.2 Keyboard-Based Techniques

- Chord keyboards
  - Extreme use of binary encoding
  - Twiddler 2: 12 keys, no more than two need to be pressed simultaneously
  - (Had lowest user performance and acceptance [Bowman 02])



Twiddler 2

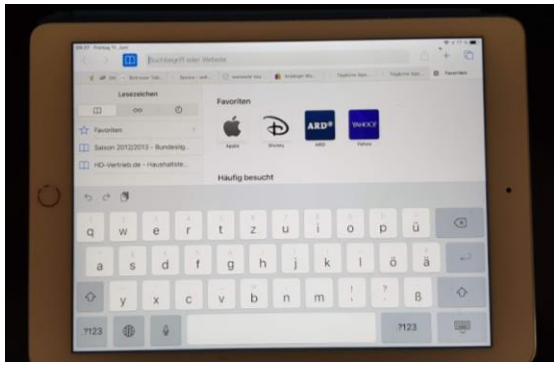
3.2 Keyboard-Based Techniques

- Pinch keyboards (using pinch gloves) [Bowman and Wingrave 01]
  - Emulation of QWERTY keyboard
    - Fingers of left hand assigned to keys in a row (home row)
    - Tracked hand rotation (left-right) moves fingers within a row, tracked hand motion (forward-backward) changes rows
    - Graphical feedback
    - Special gestures for space (thumb-to-thumb), backspace, delete all, and enter
  - (Slower than speech and soft keyboard, but easy to learn, comfortable to use)

FaceSpace

3.2 Keyboard-Based Techniques

- Soft (virtual) keyboards
  - Virtual device:
    virtual keys on a screen or surface,
    selected with finger(s) or stylus
    - Single, sequentially used input device
    - No/reduced haptic feedback
      (no blind typing)
  - (Second only to speech)



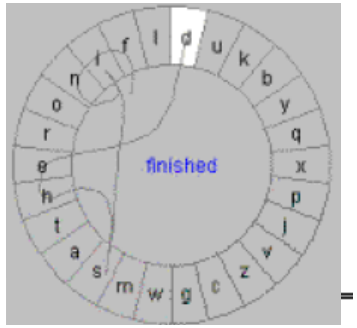
Hologram Keyboard, Zeerkers bluetooth laser

3.3 Pen-Based Techniques

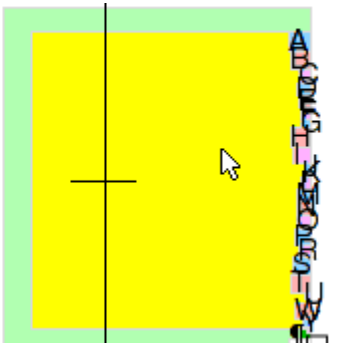
- Pen-stroke gesture recognition
  - Character-level
    - PalmOS Graffiti alphabet
  - Word-level
    - Apple Newton: cursive handwriting
    - Cirrin
    - Dasher

      http://www.inference.org.uk/dasher/DasherSummary2.html
    - Virtual Notepad

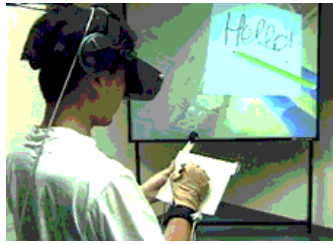
      http://www.hitl.washington.edu/projects/metaphors/handwr.html
- Unrecognized pen input (**digital ink**)
  - Arbitrary strokes are just recorded and replayed



Cirrin (word: finished)



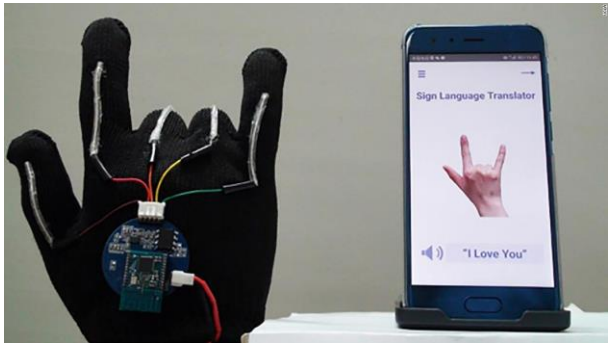
Dasher
https://www.youtube.com/watch?v=nr3s4613DX8



Virtual Notepad

3.4 Gesture-Based Techniques

- Sign language gestures
  - GloveTalk
    (signing as input to speech synthesizer)
    - Data glove
- Numeric gestures
  - Very easy, clear gestures
- Instantaneous gestures
  - Pinch gloves for instantaneous (event-based) input
  - Limited gestures



CNN Health, 2020

Gesture-based interaction has fallen somewhat out of favor in the 3D interaction community (difficulty with gesture recognition, calibration of data gloves etc)

3.5 Speech-Based Techniques

- No hands required!
- Utilizes an untapped input modality
- Efficient and precise entry of large amounts of text
- Yet, rarely used for symbolic input (only for control)
- Techniques:
  - Single-character speech recognition („spelling“)
    - Useful for filenames etc
  - Whole-word speech recognition
    - Lexicon of words
  - Unrecognized speech input
    - Just record and replay

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4. Design Guidelines

- Use the QWERTY layout, if symbolic input will be infrequent, or if most users will be novices.
- Haptic feedback is an important component of keyboard use, so use keyboards with physical buttons, if practical. If using virtual keyboards, place the virtual keys on a physical surface.
- Don‘t neglect user comfort.
- Don‘t assume that speech will always be the best technique.

4. Design Guidelines

- Consider specialized, nonstandard devices and techniques **only if** users will be entering symbols very frequently.
- Use unrecognized digital ink when speed is the most important aspect of usability.

Thank you!