Oliver Schönleben
Computers and Humans
Computer Characteristics
Input, Processing, Output

Limitations
HSI (Design) Issues and Usability Basics
Paper Issues
Focus

● Usability-relevance

● Most interesting parts

● "Eclectic"
Computers and Humans

The computer is one of the main working tools today for ...

- Researchers
- Teachers and students / scholars
- Clerks, craftsmen, business people, housewives/husbands
- Industry (managers, workers)

It is also means of entertainment

- Consumer electronics
- Games
Actually, computers are everywhere

- Cell phones
- In the car
- At home

Buzzwords

- Ubiquitous computing
- Embedded systems
Questions
Interactive Systems:
Allow user-input affecting run-time behaviour
(time, state)

Problems:
What input is expected / must be dealt with?

Decisive for how I "sense" my computer (software) as a tool (look and feel)

Growing into it
Metaphors as utility to the growth-into desktop metaphor
Traditional Interfaces

Switches and Sliders

Car controls

Musical Instruments

analogue
digital

CE-Products

Tapes, Cassette decks
Phono, CD
VCR, DVD-Players
HCI

Definition **HCI**: Human-computer interaction (HCI) is "concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."

(ACM SIGCHI 1992)

Interaction is a process of information transfer.
Input – Processing – Output

- **Input**
  - Text input devices
  - Pointing/positioning devices

- **Processing**
  - Computing units
  - Memory (different sorts)

- **Output**
  - visual: text, image, video
  - auditory: sounds, music, speech
User Interface Design

**UI Design Goals:**
- Effectiveness
- Efficiency
- Ease of use
- Fun-of use
- Accessibility

**Buzzword:** *Usability*

**UI Key Features:**
- Visibility
- Feedback
- Constraints
- Mapping (intuitive rel. between control and model)
- Consistency
- Affordance
UI Features in Traditional Interfaces

Visibility
Feedback
Constraints
Mapping (intuitive rel. between control and model)
Consistency
Affordance

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Batch Input vs. Interactive Input

**Batch:** Much data is to be input at once
- Data entry
- Programming

**Interactive:** Data input when prompted
- Considering former output

Applications with UI
- (Office, Games, ...)

Jaquard loom

Organs
Batch Input vs. Interactive Input

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![Commodore 64 Basic](image-url)
Input Devices

Textual input
  keyboards
  handwriting recognition

Pointing and positioning (also gestures)
  Mouse, touch pad, tablet, pen, stylus, finger, ...

Multimedial
  Camera (pictures, videos)
  Microphone (sounds, music, speech)
Keyboard Layouts

**German QWERTZ**

![German QWERTZ keyboard layout]

**France AZERTY**

![France AZERTY keyboard layout]

**Swiss QWERTZ**

![Swiss QWERTZ keyboard layout]

**Belgium AZERTY**

![Belgium AZERTY keyboard layout]
Alternative Key Layouts

Alphabetical Layout (aided by T9)

NEO Layout (2004)

RISTOME Layout

Dvorak Layout (1932)
Why Alternative Key Layouts?

Health Issues
- Clinical pictures (symptoms)
  - Fatigue
  - Stress, Pain
  - RSI
  - CPT
  - Tendersynovitis

Productivity Issues
- Efficiency by
  - speed
  - accuracy
- NEO-Crowd claims:
  - Learning a new layout takes 25h - 100h
  - One can "switch back"
Alternate Layouts Paradigms

- Most frequent words in home row
  - (QWERZ 75, Dvorak 1400, NEO 3600)
- Bias towards German, English, Programming (NEO)
- Consider frequencies of characters and combinations (at least digraphs)
- Most possible alternation of hands (left-right)
- Heaviest load on strongest fingers
- Design for right-handed (and left-handed) people
- Avoid confusion (Y <> Z, A <> Q)
- NOT: Try to reduce learning (adapting) period
Zipf: $p(n) \sim \frac{1}{n}$

finger paths
Reformed Keyboards

- One character per key-press
- Different physical layout
- Alternate key layout
- Health and Accessibility

Standard-Model £ 375.00

Left-hand version
Mouth stick version
Alternative Keyboards

Keyboard & Trackpad
The light projected onto the table works as the keyboard and the trackpad. The movement of the hands is calculated with a sensor that is separately installed.
Other Keyboards

Original Underwood Typewriter

On-screen keyboards

Septambic Keyer (Buzzword: *Wearable Computers*)

Musical keyboards
Chord Keyboards

Velotype / Veyboard

Braille Writer

Used for Closed Captioning

Estenotopia:
A trained court reporter or closed captioner must write speeds of approximately 225 words per minute at very high accuracy in order to pass the Registered Professional Reporter test.
Improvements Overview

Frog Pad
Graphical recognition vs. *stroke* recognition (stenographic recognition?)

Speech recognition
Next: Pointing & Positioning
Indirect medium
Relative movement
3 Buttons (at least)

Direct mapping
Ergonomic properties?
Wheel with tactile feedback (except MS)
Mouse

Inventor: Douglas Engelbart (1960s)

Indirect medium (cf. touchscreen)

Direct mapping (cf. joystick)

Ball mice and optical mice

Footmouse
Other Positioning Devices
Space Positioning
Eyetracking

Military developments

Heatmap of a web page

SecurityMax

"Sasser", "Blaster" and "MyDoom": Why Your Network Can't Stop Them

Internet Security Webinar

The "Virtual Patch" process protects your systems from attack during the window of time between the discovery of vulnerability and the availability and practical application of a security patch. Upon notification of a new threat, a "Virtual Patch" can be rapidly applied across an enterprise through the central management application.

Monday, December 13th

Register Now
Motion Capturing (MOCAP)
Next: Output
Visual / optical

Text, image (diagrams, photos), video
visual controls (oblique input "devices")
Issues: readability, mapping, user-experience

Auditory (auditory)

(s semantic) sounds, music
Issues: mapping, accessibility
verbal: speech output (speech synthesizer)

Tactile / haptic

Vibration
mechanical

General Issues: accessibility, health, usability
Output Devices: Monitor Types

CRT
- Random scan display (vector display)
- Raster Scan
  - Flat-screen vs. Triniton

LCD
- DSTN
- TFT

Plasma monitors

E-Paper

JumboTron
Monitor Issues

- Usability, Accessibility
- Readability
- Health issues
- Hazardous radiation (CRT)
  - UV and heat radiation, X-rays (rear),
  - EMR -> induction
- Compromising emission (security)
Other Output Devices

Optical:
- 3D displays
  - 3D-Specs
  - VR-Goggles
- Beamers
- Special applications
  - Ticker
  - Laser show
- Illuminated Buttons etc.
- Paper

Others:

Auditory
- Speakers
- Headphones

Tactile or haptic
- Vibration
- Force-Feedback

Special users
- Braille

Braille
Paper Characteristics

Disadvantageous:
- Costs
- Static
- Non-electronic
- Can be less enjoyable

Advantageous:
- More information possible
  - screen: 72-110dpi
  - paper: 300-900dpi
- Can be more comfortable:
  - reflected, not direct light
- handy, portable

Buzzword: Paperless office(less-paper-office)
# Printing and Scanning

<table>
<thead>
<tr>
<th>Types of Printers</th>
<th>Types of Scanners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dot-Matrix</td>
<td>Hand-held</td>
</tr>
<tr>
<td>Ink</td>
<td>Flat-bed</td>
</tr>
<tr>
<td>Bubble</td>
<td>Applications</td>
</tr>
<tr>
<td>Laser</td>
<td>OCR</td>
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<tr>
<td>LED</td>
<td>Musical Score</td>
</tr>
<tr>
<td>Plotters</td>
<td>Recognition</td>
</tr>
<tr>
<td>Braille</td>
<td></td>
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<tr>
<td>&quot;Industrial&quot;</td>
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Next: Processing
The computer is the participant in the interaction that runs a program.

Processing is the effort the computer makes to do the computational part.

Hardware limitations

Components needed

  Computing processors
  Memory
  Interfaces to the input/output devices
  Operating system to drive them all
Memory

Very-short-term memory
- Registers (bytes)
- CPU burst cache (kilo-bytes)

Short-term memory
- RAM (giga-bytes)

Long-term memory: totally persistent, slow
- ROM (WORM, EPROM, Flash-ROM, mega-bytes)
- HDDs: have own caches (MiB), solid-state hybrids (GiB)

Network storage devices
- Optical discs, SD-Chips etc.
Memory Issues

Size limitations
   => compression

Speed
   => sophisticated management (paging etc.)

Data integrity
   => Power supply (UPS)
   => backups on persistent media
Processing Hardware

- **CPU**: main general-purpose computing agent
- **Co-processors for special computations**
  - FPU for floating point calculations
  - GPU for difficult graphic related (3D) computations (architecture enables diversion for other tasks)
    - Video decoding (and even encoding)
    - Further support of 2D computations
    - Real-time physics calculations
  - Actual physical processors
- **Peripheral hardware**: bus, chipset ICs, fans etc.
Constraints (Problems)

- Slow processors (hardware)
  - Targets: desktops, handhelds etc.
  - Symptoms: Cursor tracking, icon wars, ...
  - Remedy: Hardware engineering, Software Developers' Awareness

- Problem hardness
  - Targets: non-reactive, algorithmic systems
  - Symptoms: No termination even on fast machines
  - Remedy: Scientific research

- Functional faults (bugs)
  - Targets: all systems/platforms
  - Symptoms: unexpected, defective, possibly harmful behaviour
  - Remedy: Software Engineering

- **Keyword**: usability
Implications for HCI-Design

- **Pretty clear by now:**
  - keep restrictions in mind.
  - Do not conquer the customer's desktop (e.g. respect standards)
  - Reach for the introduced goals (effect., access.)
    - Utilize simple patterns
    - E.g.: give feedback

- **Still open issues:**
  - Other components in the workplace concerning ergonomics
  - Advanced usability
    - (fun-of-use etc.)
    - Concepts & patterns
      - Mapping
      - Modus (context)
      - Feedback & Control
Computer I/O