Software-Ergonomics

Design of User Interface and Information

**Software-Ergonomics and User Interface**

**Definition:**

- **Dialog:** Interaction of user and application system
- **User Interface:** Interaction medium of the user and the application system
- **Software-Ergonomics:** Adaptation of software to humans, so that the user is not strained by the interaction with the computer more than necessary, but rather supported in his work.

**User Interface**

It should ensure an effective and less strained working.

The Man-Computer Interface contains:

- Input Devices
- Output Devices
- User Interface

**Definition:** The user interface is defined by the components of a man-computer-system, which the user is connected to in a conceptual and motor way.
1. **Examining the dexterity and skills of potential users**
   A reasonable division of labor between man and computer can be undertaken with the aid of analysis. More complex tasks can be divided into subtasks.

2. **Define the kind of interaction**
   Here it has to be clarified,
   - what kind of type of input/output (Text, Graphic,...),
   - what kind of input/output device (keyboard, mouse, monitor,...) and
   - what kind of data representation (window technique, scrollbars,...) should be chosen.

3. **Choosing a suitable dialog form between man and computer**
   Generally, the three below listed forms can be mentioned
   - computer-based dialog
   - user-based dialog
   - hybrid dialog.

### User Interface

**Interaction and Dialog Design**

- **Computer-Based**
  - Menu
  - Dialog containing layout instructions (Prompting)
  - Form dialogue

- **Hybrid**
  - Dialogue with changing initiatives
  - Dialogue with alternative layout possibilities

- **User-Based**
  - Command language
  - Transaction code and keyword technique

### User Interface

**Interaction Technique**

<table>
<thead>
<tr>
<th>Dialogue forms</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question-Answer</td>
<td>Machine poses questions, user answers</td>
</tr>
<tr>
<td>Formulare</td>
<td>User fills in a questionnaire, which is displayed on the screen</td>
</tr>
<tr>
<td>Function keys</td>
<td>User chooses options via keys, which are assigned to certain functions</td>
</tr>
<tr>
<td>Menu</td>
<td>User chooses options, which are divided into subsets, and are presented step-by-step.</td>
</tr>
</tbody>
</table>
### User Interface

Interaction and dialogue design

#### Menus

<table>
<thead>
<tr>
<th>Menu Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permanent Menu</td>
<td>Separately displayed list of options (horizontal, vertical, radial)</td>
</tr>
<tr>
<td>Embedded Menu</td>
<td>Options appear as marked position in the graphic or text</td>
</tr>
<tr>
<td>Dynamic Menu</td>
<td>Fade-in menu (pop-up)</td>
</tr>
<tr>
<td>Drop-down menu</td>
<td>Options appear in the window, linked to the menu bar</td>
</tr>
<tr>
<td>Cascade menu</td>
<td>Additional options appear when marginally leaving the window with the mouse</td>
</tr>
</tbody>
</table>

#### User-controlled dialogue forms

<table>
<thead>
<tr>
<th>Dialogue Forms</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command language</td>
<td>User formulates the input using a special language</td>
</tr>
<tr>
<td>Query language</td>
<td>A special command language for database information queries</td>
</tr>
<tr>
<td>Direct manipulation</td>
<td>User interacts with graphical objects and receives immediate feedback</td>
</tr>
<tr>
<td>Natural language</td>
<td>Exchange of information between man and machine in a language of interpersonal communication</td>
</tr>
<tr>
<td>Multimedia</td>
<td>User interacts with video and audio signals</td>
</tr>
</tbody>
</table>

#### Criterion for Designing User Interfaces

- Analogy and Metaphors
- Training and Practice
- Feedback
The human perception tends to reduce the available information set via selective processing.

The human system is permanently affected by
- the overall input of approx. 10^9 Bit/s, whereas
- the consciousness acquires only approx. 100 Bit/s.

From this it follows that all important information needs to be available in a suitable small amount and the information needs to be easily interpretable.

Criterion for the information design:
- a) Perceptibility of the information
- b) Encoding of the information
- c) Spatio-temporal organization of the information

**Perceptibility of the information**

- Minimal character height [mm]
- Observation distance [mm]
- Optimal: 4 mm letters at 75 cm on-screen distance
### Information Design

#### Encoding the Information

**Feature:**
- **Shape:** Figure
  - 123 ABC
- **Form:** A A A
- **Texture:**
- **Color:** Hue
  - magenta, blue, cyan, green, yellow, red
  - Saturation
  - Brightness
  - Contrast
darker, lighter background
- **Place:** Position
- **Orientation:**
- **Time:** slowly, rapidly, continuous, discrete

### Graph

- **Transfer Information [bit]**
- **Stimulus Information [bit]**

### Diagram

- **Optic Angle**
- **Position in the Visual Field**
Information Design

Distribution of Attention

- Vicinity
- Symmetry
- Similarity

Spatio-temporal Organization of the Information

Supplementary design characteristics can be used in addition to the organization of the information. Such as:

- Vicinity
- Symmetry
- Similarity

Design Rules

Rules of Similarity:

Rules of Vicinity:

Similarity over Vicinity:
### Information Design

**Grouping**

- **Without Grouping**
  - DIN 66234
  - 1234567DM
  - 0203564329

- **With Grouping**
  - DIN 66 234
  - 123 456 7 DM
  - 0203 / 56 43 29

### Information Design

Structuring the information without consideration of color

Categorization of the information according to color

Consideration of boundary conditions and restrictions

<table>
<thead>
<tr>
<th>Physical restriction of the eye</th>
<th>Psychological influence factors</th>
<th>Technical influence factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>- color blindness</td>
<td>- synesthetic effect of colors</td>
<td>- light conditions</td>
</tr>
<tr>
<td>- color asthenopia</td>
<td>- learned emotions and moods</td>
<td>- used hardware</td>
</tr>
<tr>
<td>- chromatic aberration</td>
<td>- effect of the lighting color</td>
<td>- positive/negative</td>
</tr>
<tr>
<td>distribution of the color receptors on the retina</td>
<td>- workaday meaning of individual colors</td>
<td>- presentation emotion</td>
</tr>
</tbody>
</table>

Assigning colors to the information categories

### Information Design

**Reference Scheme of Colours**

by the US Department of Defense

<table>
<thead>
<tr>
<th>Color</th>
<th>Meaning</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>alarm</td>
<td>flashing in case an immediate reaction is necessary</td>
</tr>
<tr>
<td>Yellow</td>
<td>caution</td>
<td>marginal situation; beware</td>
</tr>
<tr>
<td>Green</td>
<td>alright</td>
<td>self-handling; status is satisfactory</td>
</tr>
<tr>
<td>White</td>
<td>undefined</td>
<td>undefined state; transitional state; representation of alternatives</td>
</tr>
<tr>
<td>Blue</td>
<td>Auxiliary color</td>
<td></td>
</tr>
</tbody>
</table>
Information Design

Combination of colors for characters and background (Recommended according DIN)

<table>
<thead>
<tr>
<th>Background</th>
<th>Black</th>
<th>White</th>
<th>Magenta</th>
<th>Black</th>
<th>Cyan</th>
<th>Green</th>
<th>Yellow</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>White</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Magenta</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Black</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cyan</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Green</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Yellow</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Red</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*: suitable color combination  -: unsuitable color combination

Pictograms

The human perception partly occurs:

- data driven
- expectation driven

Data driven: The processing of information concerning sensory data occurs automatically in one direction.

Expectation driven: The recognition of sensory data, which are led by hypotheses of the corresponding higher cognition levels.
Pictograms

Advantages of pictograms:
• Pictograms free the short-term memory and thereby offer the mind more capacity to solve problems.
• Semantic contents, through pictograms onscreen, can be grasped immediately.
• Pictograms make better use of memory capacity in comparison with words.
• Pictograms link the new knowledge with existing knowledge.
• Pictograms feature as space-saving.

Disadvantages of pictograms:
• They are not as flexible and multifaceted as verbal information carriers.
• It is easier to represent words in a differentiated way than pictures.
• A syntactical connection of two pictograms is extremely difficult.

Design criterion for pictograms:
• Pictograms should have a high degree of abstraction and simplicity.
• Outlines can be better reached via contrast than via marginal lines.
• The line width should be sufficiently broad.
• The line management of pictograms should be direct at the horizontal and vertical principal axis.
• Similar features should be represented in similar symbols.

Design of User Interface

Rules for the Design of User Interfaces according to ISO 9241 Part 10:
Drafted by B. Shneidermann

• Attempts to reach consistency
  Similar situations should be followed by similar actions.

• Offering shortcuts to experienced users
  The frequent use of a system increases the desire to reduce the amount of interactions. This can occur via function keys, hidden commands or macros.

• Offering informative Feedback
  After the user has carried out an action, this action should always be followed by a visual feedback correspond to the undertaken action.

• Dialogues should be completed
  It should be made clear for the users if a dialogue has a beginning, a middle and an end, which he can use as guideline.

• Offering a simple error handling
  The system should detect errors and offer a simple error handling.

• Offering simple undo possibilities
  The system should offer undo capabilities, so that the system returns into the former state and thus avoids that the user gets into an impasse.

• Support user-driven dialogues
  The user should be able to control the dialogue. Unexpected system actions, long data input sequences or difficulties accessing the data should be avoided.

• Reducing the strain on the long-term memory
  This could take place by using simple screen contents or system facilities.