9. GUI: Design and Ergonomics

9.1 Overview
9.2 Menus and dialogs
9.3 Models of the human-computer interface (HCI)
9.4 Design criteria
9.5 Usability and interaction

Course Structure

- Introduction
- Human cognition and perception (aspects of human actions and perception)
- Color perception and color models
- Graphical output devices
- Raster graphics
- 2D graphics
- Interaction
- GUI: foundation, basics
- GUI: toolkits, development
- Usability engineering
- 3D computer graphics: objects, transformations, visibility, illumination, shading
9.1 Overview

Graphical user interfaces: Design

- Use of menus and dialogs
- Element arrangement, grouping, keyboard shortcuts/accelerators
- Placing: pull down, pop up, pie, transparency
- Dialogs: completion, option/list selection
- Models of HCI
  - Seeheim, model-view-controller, document-view, PAC

Graphical user interfaces: Ergonomics

- Design criteria
  - Standards (ISO)
  - Rules (Shneiderman's 8 Golden Rules)
  - Metaphors
- Usability engineering
9.1 Overview

Why was the iPod and the iPhone user experience such a success?

Good Design!
Affordance, Mapping, Visibility, Feedback

9.2 Menus and dialogs

9. GUI: Design and Ergonomics

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9.3 Models of the human-computer interface (HCI)
9.4 Design criteria
9.5 Usability and interaction
9.2 Menus and dialogs

Selection of commands by pointing & selecting

• Binary

• Arrangement for several elements
  – Typically in lines
  – Functional, alphabetical, according to importance or relative frequency
  – Grouping by dividing lines
  – Width vs. depth
  • If more than 7 ± 2 entries
    – Cascading menus
    – Selection dialogs
  – Non-selectable entries: insensitive

Acceleration by keyboard selection

• Accelerator keys vs. shortcuts
9.2 Menus and dialogs

Pull-down vs. pop-up menus

• Pull-down menus:
  – Permanently available via menu bars
  – Standardization

• Pop-up menus:
  – Appear by user request (e.g., right mouse button) or automatically (interaction required)
  – Depend on
    • Selected object
    • Underlying windows
  – Advantage: minimum cursor movement
  – Disadvantage: bad for beginners because existence may be unclear (e.g., in xterm: Ctrl-right)
9.2 Menus and dialogs

Menu variants

• Transparent menus
  – No occlusion

• Pie menu
  – Selection via direction (e.g. in Second Life)

Example from Second Life

Link: http://wn.com/pie_menu
9.2 Menus and dialogs

Example from Second Life

Pie menu problem

- Navigating hierarchies
  - No hierarchy visible
  - Main menu occluded

- Possible solution
  - Pull-down submenus
  - **But:**
    Long distances between submenus

- Therefore
  Second Life 2.0 uses standard menus
9.2 Menus and dialogs

Dialog window

• Combination of interaction elements
  – Simultaneous selection and text/value input
  – Explicit completion/activation

• Options
  • 1 from n: radio box
  • m from n: check box

• List selection
  • 1 from n: combo box
  • m from n: list box

Is this the right control?

1. Use radio buttons if the meaning of the cleared check box isn’t completely obvious.

2. A check box is an efficient use of screen space for this peripheral option.

3. A drop-down list focuses on the current selection and discourages users from making changes.
9.2 Menus and dialogs

Faceted Search: Example

Faceted search:
(1) select

facet attribute

facets

(2) filter

result set

(3) update

number of results

facet category

facet count

facet attribute

Audiobooks

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9.2 Menus and dialogs

Faceted Search: Advantages

- Facets and their attributes are given (reduced effort)
- Attributes are categorized (understanding)
- No facet attribute can lead to an empty result set
- Resulting number of results is shown in advance
- Rapid update of result set (dynamic queries)
- Selected attributes are shown and can be deselected

Information access in the Semantic Web

Hierarchy: National team has Player born in Country

- **Common Web:**
  Entering words in an input field (e.g. Google or Bing)

- **Problem: Ambiguity**
  Natural language is ambiguous!
  Finding the right information, however, requires the semantic of what should be searched to be specified by the user.

- **Solution:**
  Artificial query languages like SPARQL that are uniquely defined.
  Access via SPARQL endpoints (e.g. DBpedia or the LOD cloud).

```
SELECT DISTINCT ?object ?label
WHERE { ?object rdf:type <URI of Football player> .
  ?object rdfs:label ?label . }
```
9.2 Menus and dialogs

Information access in the Semantic Web

- **Problem:** Required knowledge
  SPARQL requires the language to be learned by the user (rather a task for experts).

- **Solution:**
  Intuitive graphical interfaces to express search queries that are semantically unique but do not require any extra knowledge!

How can they look like?

---

9.2 Menus and dialogs

Information access in the Semantic Web: Facet Graphs

DEMO
9.3 Models of HCI

9. GUI: Design and Ergonomics

9.1 Overview
9.2 Menus and dialogs
9.3 Models of the human-computer interface (HCI)
9.4 Design criteria
9.5 Usability and interaction

- Reference models for HCI implementations
- Often basis for
  - Design of GUIs
  - Development of tools for GUI generation
- Two main aspects
  - Separation of user interface and application
  - Consistency between application data and visible representation
- Approaches:
  - Layer models: procedural approach
  - Object-oriented models: cooperation of objects
  - Device models: standardization of input/output devices; less important today
9.3 Models of HCI

**Seeheim model (layer model)**

- UIMS Workshop 1983 (User Interface Management Systems)
- Layer model only partly suitable for direct manipulation

![Layer Model Diagram]

- **Static part**
  - "look" (Xlib / Xt)
- **Dynamic part**
  - "feel" (callback)
- **Semantic layer**
  - Action (Xlib / Xt)

9.3 Models of HCI

**Model-view-controller (MVC)**

- Object-oriented model: communication between interaction objects
- Inter-object modeling: Cooperating objects for
  - Presentation
  - Dialog control
  - Application access
- **Idea**: Separate
  - Application data and logic from
  - Presentation and manipulation
- **Examples**: Adobe Flex, Java Swing, Smalltalk
9.3 Models of HCI

Model-view-controller (MVC)

- **Controller**: interface to events
- **View**: visible representation of the component
- **Model**: state of the component

MVC as introduced in SmallTalk (1992)
9.3 Models of HCI

Model-view-controller (MVC)

MVC in event-driven systems

Observer pattern \[3\]
(a subset of the publish/subscribe pattern)
9.3 Models of HCI

MVC in event-driven systems

Observer pattern (a subset of the publish/subscribe pattern)

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9.3 Models of HCI

MVC in event-driven systems
9.3 Models of HCI

MVC in event-driven systems

Benefits

• Minimal coupling between the Subject and the Observer
• Can reuse subjects without reusing their observers and vice versa
• Observers can be added without modifying the subject
• All subject knows is its list of observers
• Subject does not need to know the concrete class of an observer, just that each observer implements the update interface
• Subject sends notification to all subscribed observers
• Observers can be added/removed at any time
9.3 Models of HCI

MVC Example

Model:
Minimum = 0
Maximum = 100
Value = 15
Width = 5

View:

Controller:
Accept mouse clicks on end buttons
Accept mouse drag on thumb

Model updating Views when data changes
Controller changes Model or Views
Event is passed to the Controller

Multiple controllers

Action Listener

Link: http://www.enode.com/x/markup/tutorial/mvc.html

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9.3 Models of HCI

MVC in Java Swing (model-delegate)

View and controller are merged into delegate

PAC model

- Coutaz [1987]
- PAC = presentation-abstraction-control
- Presentation: handles input/output, the visible components, is typically changeable
- Abstraction: handles application semantics
- Control: handles interaction and the dialog between “presentation” and “abstraction”
9.3 Models of HCI

**PAC model - characteristics**

- Input and output are handled together by PAC (in contrast to MVC)
- Explicit task of the “control” component of PAC
  - Ensure the consistency between “presentation” and “abstraction”
  - MVC: Consistency has to be ensured by the developer
- General problem: Notification between components
9.4 Design criteria

9. GUI: Design and Ergonomics

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9.4 Design criteria
9.5 Usability and interaction

Bad design

- Elevator controls and labels on the bottom row all look the same, so it is easy to push a label by mistake instead of a control button

- People do not make same mistake for the labels and buttons on the top row. Why not?

From: [http://www.baddesigns.com/elecon.html](http://www.baddesigns.com/elecon.html)
9.4 Design criteria

Why is this vending machine so bad?

- Need to **push button first** to activate reader
- Normally **insert bill** first before making selection
- Contravenes well known convention

From: [http://www.baddesigns.com/parking2.html](http://www.baddesigns.com/parking2.html)

9.4 Design criteria

How to build good interactive systems?

- Combine knowledge about
  - The technical possibilities
  - The physiological, psychological aspects
- Orientation on:
  - Laws and regulations
  - Standards
  - Rules
  - Style guides (look-and-feel industry standards)
  - Development tools (APIs’ UI builders)
- Standards:
  - DIN EN ISO 9241 parts 10-17 (since 1990)
  - DIN EN ISO 13407 (1999)
9.4 Design criteria

- Bildschirmarbeitsverordnung (geltendes Recht in Deutschland)

Zusammenwirken Mensch – Arbeitsmittel


21. Bei Entwicklung, Auswahl, Erwerb und Änderung von Software sowie bei der Gestaltung der Tätigkeit an Bildschirmgeräten hat der Arbeitgeber den folgenden Grundsätzen insbesondere im Hinblick auf die Benutzerfreundlichkeit Rechnung zu tragen:

21.1 Die Software muss an die auszuführende Aufgabe angepasst sein.

21.2 Die Systeme müssen den Benutzern Angaben über die jeweiligen Dialogabläufe unmittelbar oder auf Verlangen machen.

21.3 Die Systeme müssen den Benutzern die Beeinflussung der jeweiligen Dialogabläufe ermöglichen sowie eventuelle Fehler bei der Handhabung beschreiben und deren Beseitigung mit begrenztem Arbeitsaufwand erlauben.

21.4 Die Software muss entsprechend den Kenntnissen und Erfahrungen der Benutzer im Hinblick auf die auszuführende Aufgabe angepasst werden können.

22. Ohne Wissen der Benutzer darf keine Vorrichtung zur qualitativen oder quantitativen Kontrolle verwendet werden.

Core ISO standards for usability

- ISO 9241 parts 1-17
  - “Ergonomic requirements for office work with visual display terminals”
  - Parts 1-9: hardware, environment
  - Parts 10-17: software
    (new parts: 100 and above, e.g. 110 is the update of 10)

- ISO 13407
  - “Human-centered design processes for interactive systems”

- ISO committees
  - ISO Technical Committee TC 159 “Ergonomics”
  - Sub Committee SC 4 “Ergonomics of Human System Interaction”
  - Working Group WG 5 “Software Ergonomics”
9.4 Design criteria

Criteria of ISO 9241 parts 11 (Guidance on Usability)

- **Effectiveness**: How precisely and completely does a user reach a goal?
- **Efficiency**: What effort was necessary to reach a certain level of precision and completeness?
- **Satisfaction**: Lack of adverse effects and positive attitude toward using a program.

ISO 9241 parts 110 (Dialogue Principles)

- Dialog Problems, examples
- Understanding ISO 9241/110
9.4 Design criteria

Terms of ISO 9241 parts 110 (Dialogue Principles)

• Suitability for the task
• Self descriptiveness
• Controllability
• Conformity with user expectations
• Error tolerance
• Suitability for individualization
• Suitability for learning

EN ISO 9241-110: Suitability for the task

“A dialog supports suitability for the task, if it supports the user in the effective and efficient completion of the task. The dialog presents the user only those concepts which are related to the user’s task. “

⇒ Hide internal tasks from user
⇒ Task-oriented information input/output
⇒ Macros and defaults for recurring subtasks and data
⇒ Store old data values for reuse requested by the user
⇒ Know users and their tasks
⇒ Concentration on important control actions
9.4 Design criteria

EN ISO 9241-110: Suitability for the task

Mapping

• Relationship between controls and their movements and the results in the world
• Why is this a poor mapping of control buttons?
9.4 Design criteria

EN ISO 9241-110: Suitability for the task

Mapping

• Why is this a better mapping?

• The control buttons are mapped better onto the sequence of actions of fast rewind, rewind, play and fast forward

EN ISO 9241-110: Self descriptiveness

“A dialog supports self-descriptiveness, if each dialog step is immediately comprehensible through feedback from the system or is explained to the user on his or her requesting the relevant information.”

⇒ User-adapted, context-sensitive help
⇒ Visibility of the system status
⇒ Clarify possible actions
⇒ Consistent terminology for feedback
⇒ Minimize need for reading the manual
9.4 Design criteria

EN ISO 9241-110: Self descriptiveness

Logical or ambiguous design?

- Where do you plug the mouse?
- Where do you plug the keyboard?
- Top or bottom connector?
- Do the color coded icons help?

From: www.baddesigns.com
9.4 Design criteria

EN ISO 9241-110: Self descriptiveness

How to design them more logically?

(i) A provides direct adjacent mapping between icon and connector

(ii) B provides color coding to associate the connectors with the labels

From: www.baddesigns.com

9.4 Design criteria

EN ISO 9241-110: Controllability

“A dialog supports controllability, if the user is able to maintain direction and speed over the whole course of the interaction until the point at which the goal has been met.”

- Ability to interrupt and continue partial dialogs
- Cancelable actions (undo)
- Adaptive interface (user’s choice of input/output style)
  - Different hardware (PDA vs. large screen)
  - Beginner, occasional, and experienced users
  - Different (cognitive) abilities
- Speak the language of the user
9.4 Design criteria

EN ISO 9241-110: Controllability

EN ISO 9241-110: Conformity with user expectations

“A dialog supports conformity with user expectations, if it corresponds to the users task knowledge, education, experience, and to commonly held conventions.”

- Uniform dialog behavior
- Similar dialogs for similar tasks
- “Principle of least astonishment”
- Scalable feedback (e.g. response time)
9.4 Design criteria

EN ISO 9241-110: Conformity with user expectations

**Consistency**

- Design interfaces to have similar operations and use similar elements for similar tasks
- For example:
  - always use ctrl key plus first initial of the command for an operation – ctrl+C, ctrl+S, ctrl+O
- Main benefit is consistent interfaces are easier to learn and use
9.4 Design criteria

EN ISO 9241-110: Conformity with user expectations

When consistency breaks down

• What happens if there is more than one command starting with the same letter?
  – e.g. save, spelling, select, style
• Have to find other initials or combinations of keys, thereby breaking the consistency rule
  – e.g. ctrl+S, ctrl+Sp, ctrl+shift+L
• Increases learning burden on user, making them more prone to errors

Internal and external consistency

• Internal consistency refers to designing operations to behave the same within an application
  – Difficult to achieve with complex interfaces
• External consistency refers to designing operations, interfaces, etc., to be the same across applications and devices
  – Very rarely the case, based on different designer’s preference
9.4 Design criteria

EN ISO 9241-110: Conformity with user expectations

Keypad numbers layout

• A case of external inconsistency

(a) phones, remote controls

<table>
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<th>1</th>
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<th>3</th>
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<tr>
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<td>9</td>
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<td>0</td>
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</tbody>
</table>

(b) calculators, computer keypads

<table>
<thead>
<tr>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
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<td>3</td>
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<td>0</td>
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EN ISO 9241-110: Error tolerance

“A dialog supports error tolerance if, despite evident errors in input, the intended result may be achieved with either no or minimal corrective action having to be taken.”

⇒ Correction hints, correction alternatives, automatic correction
⇒ Draw attention if necessary
⇒ Constructive, user-oriented
⇒ Help to avoid user errors
⇒ Avoid the need to memorize too many things
⇒ Combine visual and language-based interaction
⇒ Make undo possible
⇒ Interpretable error messages
9.4 Design criteria

EN ISO 9241-110: Error tolerance

Plugging in a USB connector

- Which way to plug in?
- What about vertical plugs?
- You have to try it out (try and error)
- How to avoid errors?
9.4 Design criteria

EN ISO 9241-110: Error tolerance

How to avoid errors?

From: www.baddesigns.com

9.4 Design criteria

EN ISO 9241-110: Suitability for individualization

“A dialog supports suitability for individualization, if the dialog system is constructed to allow for modification to the user’s individual needs and skills for a given task.”

⇒ No substitute for ergonomically designed dialogs!
⇒ Choice of language / vocabulary
⇒ Adaptation to user deficits
⇒ Modifiable extent of explanations
⇒ Choice of the interaction technique, form of the representation
9.4 Design criteria

EN ISO 9241-110: Suitability for individualization

“...suitability for learning, if it guides the user through the learning stages minimizing the learning time.”

- Support relevant learning strategies (learning by doing, learning by the example)
- Recognizing instead of memorizing
- Consistency (interior, exterior, metaphoric)
9.4 Design criteria

EN ISO 9241-110: Suitability for learning

... and some that are only funny
9.4 Design criteria

Shneiderman’s 8 Golden Rules of interface design
1. Strive for consistency
2. Shortcuts for frequently used elements
3. Offer informative feedback
4. Closed dialogs (grouping beginning – end)
5. Easy error prevention/handling
6. Reversal of actions (undo)
7. Controllability (avoid “non-causality”)
8. Reduce short-term memory load

Metaphors
- Language pictures or images / analogy of the terms
  - Interface metaphor
  - Desktop metaphor (office: folder, trash ...)
  - House metaphor (virtual areas)
  - Travel metaphor (computer games)
  - Book metaphor (hypertext systems)
- Pros and cons
  + Easier handling of systems by “alleged” understanding
  + Can support memory
  – New possibilities remain unused
  – Possibly country-specific or dependent on cultural background
9.4 Design criteria

Dialogs: Hall of Shame

Hammer Error
Sticking force out of bounds. Nail fatally bent.

Naughty Program
Erase hard disk?
Now Later

Copier
ABB
From 'Parent' to 'Parent'
1431626 Minutes Remaining

1978 Chevrolet Caprice
Please enter steering information:
Left Straight Right

9.4 Design criteria

Dialogs: Hall of Shame

mGetGUI 1.0
You are using GNU Wget 1.9-beta - 3.7a minimum.

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9.4 Design criteria

Dialogs: Hall of Shame

Controllability interpreted differently… [P. Hummel]

9.5 Usability and Interaction

9. GUI: Design and Ergonomics

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9.5 Usability and Interaction

... and the users

- Own many different interactive devices
- Are working mobile in different places
- Suffer from information overload
- Are under pressure and have stress
- Have known cognitive limitations
- Have a higher average age every year

"The Perfect User"

9.5 Usability and Interaction

Convergence of different worlds

Users
Mental Model, Expectations, Behavior, ...

Designers & Developers
Image of user expectations and application requirements

Application & System
Functionality
User Interface
Technology

IZMF

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9.5 Usability and Interaction

Convergence of different worlds

The design model and the user's model
(based on Norman 1986 [4], p.46)

9.5 Usability and Interaction

What is Usability?

Example: Phone (system)

- Suitability for Task
- Consider the main tasks of a system for structuring user access to functions
What is Usability?

Usability and Software Ergonomics

– Analysis, Design and Evaluation of computer-based work
– Goal: adaptation of technology to abilities and needs of users and the tasks to be accomplished with the system
– **People in the focus** with their individual and social needs

– Vision:
  “The old computing was about what computers could do; the new computing is about what people can do”

  Ben Sheiderman (2002)

Traditionally:
  “Quality of Use”

Perceived pragmatic quality

Perceived hedonistic quality
  “Joy of Use”

Usability of a product: The extent to which it can be used by a user to achieve goals in a specific context in an **effective, efficient, and satisfactory** manner.

(new) Usability = Quality of Use + Quality of Experience

Hassenzahl et al. 2000

– Higher acceptance through fun of application
– Better quality of work results (emotional labor)
9.5 Usability and Interaction

Usability – hidden product quality: “Dissatisfyer”

- Good usability is normally not perceived consciously as a positive product attribute
- But bad / missing usability has direct influence on satisfaction, acceptance and frequency of use

Usability as “Trust Builder”

Positive und negative impact factors on online trust

- F1 = Authenticity
- F2 = Simple interaction
- F3 = Competency
- F4 = Credibility
- F5 = Personal / individual communication
- F6 = Advertisements
- F7 = Unprofessional Appearance

- Source: Stanford University, 2001
9.5 Usability and Interaction

Classes of test-able prototypes

- **Paper prototypes**
  The application is being simulated by paper

- **Clickable PC prototype**
  The screen sequence is simulated e.g. by Powerpoint slides

- **Emulator**
  (PC) software that simulates the behavior of the device developed

- **Wizard-of-OZ prototyping**
  Hidden operator simulates the interaction with / reaction of the system

---

Wording & Information Architecture

<table>
<thead>
<tr>
<th>Wording &amp; Information Structure for / with:</th>
<th>Definition of Terms</th>
<th>Card Sorting</th>
<th>Naming</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Links</td>
<td>Introduction of a term (e.g. “navigation bar”)</td>
<td>Introduction of correlated terms on cards</td>
<td>Introduction of a functionality or content</td>
</tr>
<tr>
<td>- Menu structures</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>- Views / object representations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Actions</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Typical Results

- Identification of vague and incomprehensible terms
- Identification of problems of the content structure
- Ensuring correct wording in conjunction with graphical representation

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9.5 Usability and Interaction

How Does Eye Tracking work?

– Basic assumption: Eye movements correspond to cognitive processes and reflect the human information processing
– Eyes fixate the object currently process by the brain
– Types of eye movement important to analyze attention:
  – **Fixations** = eye movement with the retina oriented quite fixed to a stationary object
  – **Saccades** = fast eye movement from one fixation point to the next while moving the focus of attention (no information perceived!)
  – **Smooth Pursuits** = movements occurring while following a moving object

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9.5 Usability and Interaction

How Does Eye Tracking work?

If you are interested in working with such a system!? We have one at VIS institute!

9.5 Usability and Interaction

Specification of User Requirements

**Scenarios**
Description of typical actions of persons within the planned system

**Personas**
Vivid descriptions of a user

**Use Cases**
Precise description of flows, system functionality / interaction, user tasks and roles

Different methods imply
- different level of detail
- different level of formalization
- different effort necessary
- different formats of documentation of user characterization and tasks
9.5 Usability and Interaction

**Essential Use Cases**

[Constantine & Lockwood]

- Based on user goals and sense of interactions
  - Not on concrete actions / steps to achieve goals
    (in contrast to standard use cases)
- Essential Use Cases: problem-oriented rather than solution-oriented
  (even more than use cases)
  - They leave room for possible design solutions and interaction concepts

---

**ISO 14915 Software Ergonomics for Multimedia User Interfaces**

**Suitability for communication goal**
- According to goals and tasks of the user
- According to the goals of the provider

**Suitability for perception and understanding**
- Avoid perceptual overload
- Avoid cognitive overload caused by additional tasks
- Take into account different perceptual and cognitive abilities of the user

**Suitability for Exploration**
- Support for orientation, search, and navigation
- Alternative navigation paths

**Suitability for engagement**
- Involvement of emotion
- Aesthetics
- Credibility, transparent security concept
9.5 Usability and Interaction

Guidelines and Norms

- “The Windows Guidelines for Software Design” (platform style guide, Microsoft)
- ISO/IEC 11581 and 18035: Symbols (Icons)
- ISO 13407: Human-centered design process
- ISO 14915: Software ergonomics for multimedia user interfaces
- German “Bildschirmarbeits-Verordnung” (BildscharbV) (as part of EU directive)
- ISO 9241: Ergonomic requirements for work with display terminals
  - ISO 9241-1 to -7 and -9: (not important here)
  - ISO 9241-8: Color design
  - ISO 9241-10/-110: Dialogue principles
  - ISO 9241-11: Guidance on usability
  - ISO 9241-12 to -17: Presentation of information, user guidance, menu / command / direct manipulation / form-filling dialogues

User-Centered Design Process

User-Centered Design means...

Follow / design a development process of an application such that at every point of it, the needs of the intended users are the focal point

1) Analyze: Analysis of user and context requirements
2) Interpret: Specification of user requirements
3) Create: Design of solutions as user interface prototypes
4) Evaluate: Evaluation with users

Scenario-based Design - Activity-centred Design - Context-centred Design – Human-centred …
9.5 Usability and Interaction

The Path to Generative User Interfaces

Model-based user interface development environments
MB-UIDE

User interface development environments
UIDE

User interface management systems
UIMS

Application programming interfaces
API

Mobile Devices – Trends Toward Heterogeneity

Personal Agent
– Window to the world

The world of possibilities for technical support is accessed by one single and personalized (multimodal) user interface. With this interface, context-adaptive services are accessed.

Usability Challenges:
Personalization, multimodality, adaptivity, application-integrating control, user models

Ubiquitous Computing
– Networking, integration, intelligent environments

The whole socio-technical environment represents the user interface. It is context-adaptive and adapts to the user, too, by offering a variety of interaction and service offers. Switching between different input and output devices happens seamlessly and according to the user’s goals and context.

Usability Challenges:
Complexity, consistency of applications, heterogeneity of user groups, adaptivity, new types of interaction, integration
9.5 Usability and Interaction

Ubiquitous Computing

Mobile Devices – Ubiquitous Computing [Weiser 91]

- Real world
- Augmented world model
- Source of information
- Multimedia
- WWW
- Digital libraries

Augmented Reality

Applications
- Tourist guide
- Navigation

Federation
9.5 Usability and Interaction

Augmented Reality in medicine

Augmented Reality in games
9.5 Usability and Interaction

CSCW – Computer Supported Cooperative Work

- Support for different functions:
  - **Communication**: exchange of information
  - **Collaboration**: working together on objects (documents, concepts, software)
  - **Coordination**: planning, control, monitoring of dependencies (logical and temporal) of sub-tasks

- Benefits:
  - Support for operational tasks
  - Exchange of knowledge and experience
  - Support for creative teamwork
  - Groupware is a class of tools with different scope and features for realizing CSCW

Groupware – Main Dimensions

- **Same place**
  - Video conferencing
  - Chat systems
  - Remote presentation
  - Application sharing
  - Shared media spaces
  - Presentation software
  - Whiteboard apps.
  - Group decision support systems

- **Other place**
  - E-mail
  - Shared document repositories
  - Group board
  - Calendar
  - (Same functions as above)
  - Brainstorming software
  - Rating systems

- **Synchronous**
- **Asynchronous**
9.5 Usability and Interaction

Semantic Wikis

References