INFSCI 2470
Interactive System Design

Lecture 11:
Accommodating to Individual Users

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Overview

• Interaction and adaptation
• Dimensions of differences
  – Physical abilities
  – Cognitive and perceptual abilities
  – Personality differences
  – Cultural and international diversity
• Adaptive systems and user modeling
  – Sequencing and overlay user modeling
  – Incremental interface
  – Adaptive presentation
  – Adaptive content selection
  – Integrated solutions
Interaction and Adaptation

A dialog is a process of mutual adaptation of partners
Universal Usability

• Traditional approach to developing interfaces
  – A single interfaces is designed for all users
  – One size fits all
  – If an interface does not fit, it’s the user who needs to adapt

• Universal Usability approach
  – Provisions are made to develop interfaces suitable for many categories of users and even for an individual user
Accommodation of Human Diversity

- Physical abilities
  - Users with disabilities and elderly users
- Cognitive and perceptual abilities
- Personality differences
- Cultural and international diversity
- Prospects, type of job
- Level of knowledge, skills
- Interests, goals
Physical Differences

• Anthropometry has analyzed and catalogued human dimensions
• There is no average user, either compromises must be made or multiple versions of a system must be created
• Physical measurement of human dimensions are not enough, take into account dynamic measures such as reach, strength or speed
• No aspect can be ignored
  – Left- and right-handed people
Perceptional Abilities

- Provisions should be made to accommodate for variances of the users’ sense perception.
- Vision: flicker, contrast, color blindness,
- Touch: keyboard and touchpad sensitivity
- Hearing: audio clues must be distinct
- An ability to adjust to individual differences is important
- Designers should allow for variability within their applications via settings for sound, color, brightness, font sizes, etc.
Workplace Ergonomics

- Workplace design can help or hinder work performance
- Work surface width, height, depth
- Chair’s height, angle ...
- Armrests, palmrests…
- Light, colors, texture ...
- Reachability

Aeron Chair
Users with Disabilities and Elderly Users

• Can’t adapt by simply changing the range of parameters - radically new design is required
• Early planning for users with disabilities is more cost efficient than adding on later
• Businesses must comply with the "Americans With Disabilities" Act
• Example: Tools for users with vision and hearing impairments
Memory Aid

- **Disability** - head injury, Alzheimer’s, ADD

- **Function** - planning, scheduling, cueing
Wivik On Screen Keyboard

- **Disability** - spinal cord injury, movement
- **Function** - computer access
Voice Recognition

- **Disability** - spinal cord injury, movement, hands busy
- **Function** - computer access

*writer*
Personal Reader

- **Disability** - low vision
- **Function** - access to printed media
Head Tracking

- **Disability** - amputation, movement, spinal cord injury
- **Function** - computer access
Education for special needs children

• 2% of school-age children are “special needs” children

• Examples: Autism, Attention Deficit Syndrome (ATD)

• Special procedures and software tools to enhance learning

• Smaller steps, special problems, maintaining attention...
Cognitive and Perceptual Abilities

• Factors affecting the cognitive processes
  – short-term memory
  – long-term memory and learning
  – problem solving and decision making
  – attention and set (scope of concern)
  – time perception

• Also - Factors affecting perceptual and motor performance
Personality Differences

• Personality types, individual traits, cognitive styles...

• Different groups of the population have various responses to the UI design (e.g. men vs. women)

• Myers-Briggs Type Indicator (MBTI)
  – extroversion vs. introversion
  – sensing vs. intuition
  – perceptive vs. judging
  – feeling vs. thinking

• Learning styles:
  – Kolb’s inventory, field dependence...
Cultural / International Diversity

• Characters, numerals
• Left-to-right versus right-to-left input and reading
• Date and time formats; Numeric and currency formats
• Weights and measures
• Telephone numbers and addresses
• Names and titles
• Icons, buttons, colors
• Etiquette, formality, metaphors
Changeable Characteristics

- Knowledge about the subject
- Knowledge about the system, trace of work
- Goal: local and global
- Interests: long-term and short-term
- Preferences
- Background: profession, language, prospect, capabilities
Adaptive systems

Classic loop “user modeling - adaptation” in adaptive systems
Adaptive software systems

- Intelligent Tutoring Systems
  - adaptive course sequencing
  - adaptive . . .

- Adaptive Hypermedia Systems
  - adaptive presentation
  - adaptive navigation support

- Adaptive IR systems
- Adaptive . . .
What Can Be Adapted

• Depends on the kind of the interface
• Some old (but actual!) examples:
  – Adaptive menus
    • Sort or hide options in menus
    • Restructure menus adaptively (ClixSmart)
  – Adaptive Forms
    • Do not show (or dim) irrelevant, non-necessary items
    • Provide adaptive labels for different users
Adapting to what?

- Knowledge: about the system and the subject
- Goal: local and global
- Interests
- Background: profession, language, prospect, capabilities
- Navigation history
Who provides adaptation?

• User

• "Administrator"

• System itself

• Adaptive vs. *adaptable* systems
Domain model - the key
Overlay user model: knowledge
Simple overlay model

Concept 1
yes
Concept 2
yes
Concept 3
yes
Concept 4
no
Concept N
no
Concept 5
no
Simple overlay model

- Concept 1
  - yes
  - yes
  - yes
  - yes
  - yes

- Concept 2
  - yes

- Concept 3
  - yes

- Concept 4
  - no

- Concept N
  - no
  - no

- Concept 5
  - no
Weighted overlay model
Vector vs. network models

- Vector - no relationships
- Precedence (prerequisite) relationship
- is-a, part-of, analogy: (Wescourt et al, 1977)
- Genetic relationships (Goldstein, 1979)
Vector overlay model
Network overlay model
Adaptive presentation: goals

• Provide the different content for users with different knowledge, goals, background
• Provide additional material for some categories of users
  – comparisons
  – extra explanations
  – details
• Remove or fade irrelevant piece of content
• Sort fragments - most relevant first
Adaptive presentation techniques

- Conditional text filtering
  - ITEM/IP, PT, AHA!
- Adaptive stretchtext
  - MetaDoc, KN-AHS, PUSH, ADAPTS
- Frame-based adaptation
  - Hypadapter, EPIAIM, ARIANNA, SETA
- Full natural language generation
  - ILEX, PEBA-II, Ecran Total
Conditional text filtering

- Similar to UNIX cpp
- Universal technology
  - Altering fragments
  - Extra explanation
  - Extra details
  - Comparisons
- Low level technology
  - Text programming

If switch is known and user_motivation is high

Fragment 1

Fragment 2

Fragment K
Example: SASY

Scrutable adaptive presentation

Example: Stretchtext (PUSH)

In iom we perform and document an object-oriented analysis of a subsystem. The model should include the abstractions (represented as object types) necessary to understand how the subsystem described by the functional requirements is expressed in an object-oriented world. This analysis will render us a high-level view of the subsystem without any consideration (or at least as little consideration as possible) taken to distribution, persistence aspects or other design and implementation considerations. The goal is a model that clearly describes and gives an understanding of a subsystem without the gory details of design and implementation.

The ideal object model resulting from the ideal object modelling process is functionally complete in the sense that it covers all areas of the functional specification of a subsystem.

The intention behind the ideal object modelling process is to focus on...
Indexing of page fragments

Concepts
- Concept 1
- Concept 2
- Concept 3
- Concept 4
- Concept N
- Concept 5

Node
- Fragment 1
- Fragment 2
- Fragment K
Adaptive presentation: evaluation

- MetaDoc: On-line documentation system, adapting to user knowledge on the subject
- Reading comprehension time decreased
- Understanding increased for novices
- No effect for navigation time, number of nodes visited, number of operations
Modeling User Interests

• Concept-level modeling
  – Same domain models as in knowledge modeling, but the overlay models level of interests, not level of knowledge

• Keyword-level modeling
  – Uses a long list of keywords (terms) in place of domain model
  – User interests are modeled as weighted vector or terms
  – Originated from adaptive filtering/search area
Keyword User Profiles

**Art**
- Portrait: 0.60
- Sculpture: 0.72
- Watercolor: 0.45
- Painting: 0.33

**Sports**
- Soccer: 0.88
- Bat: 0.27
- Touchdown: 0.79
- Score: 0.33

**Music**
- Rock: 0.15
- Symphony: 0.87
- Score: 0.31
- Orchestra: 0.63
Use of Profiles in Adaptive Web