

Usability of interactive systems

91.527

Human-Computer Interaction
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Usability requirements

- Synonyms for “user-friendly”
 - (Microsoft Word 2002)
 - easy to use
 - Accessible
 - Comprehensible
 - Intelligible
 - idiot proof
 - Available
 - ready



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But “friend” also

- seeks to help + be valuable
- not only understandable
 - but understands
- reliable
- doesn't hurt
- pleasant to be with



Subjective, vague measures

- → need systematic process
- to develop usable systems
 - for specific users
 - in specific context



Usability requirements (cont.)

- U.S. Military Standard for Human Engineering Design Criteria (1999)
 - purposes:



- Achieve required performance by operator, control, and maintenance personnel
- Minimize skill and personnel requirements and training time
- Achieve required reliability of personnel-equipment/software combinations
- Foster design standardization within and among systems



quality of life

- improving
 - user's quality of life
 - community
- also objectives?



Usability requires

- project management
- careful attention to requirements analysis
- testing for clearly defined objectives



Goals for requirements analysis

- Ascertain user's needs
- ensure reliability
- promote
 - standardization
 - **integration**
 - **consistency**
 - **portability**



Goals (cont.)

- ***Complete projects***
 - ***on time***
 - ***within budget***



Ascertain user's needs

- tasks & subtasks to be carried out
 - include occasionally-performed
 - common tasks easy to identify
- functionality match need
 - or users reject / underutilize



Ensure reliability

- actions function as specified
- DB data displayed reflect actual DB
- appease user's sense of mistrust
- system available as often as possible
- system must not introduce errors
- Ensure user's privacy and data security
 - protect against unwarranted access, destruction of data, malicious tampering



standardization,
integration, consistency,
portability



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Standardization

- use pre-existing industry standards where exist
- → aid learning
- → avoid errors
- e.g.
 - W3C
 - ISO standards



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Integration

- product
 - able to run across different software tools and packages
 - (e.g. Unix)



Consistency

- compatibility
 - across different product versions
- with related
 - paper
 - other non-computer based systems
- use common action sequences, terms, units, colors, etc. within program



Portability

- allow user to convert data across multiple software & hardware environments



Goals for requirements analysis

- ***Complete projects on time and within budget***
- *Late / over budget products*
- *→ serious pressure within company*
- *→ potentially*
 - *dissatisfied customers*
 - *loss of business to competitors*



Usability measures

- Define
 - target user community
 - class of tasks associated with interface
- Communities evolve and change
 - e.g., interface to information services for U.S. Library of Congress



5 human factors central to community evaluation:



Time to learn

- How long
 - for typical members of community
- to learn relevant task?



Speed of performance

- How long
 - to perform relevant benchmarks?



Rate of errors by users

- How many
- what kinds
- errors made during benchmark tasks?



Retention over time

- Frequency of use
- ease of learning
- → help make for better user retention



Subjective satisfaction

- user feedback
 - interviews
 - free-form comments
 - satisfaction scales



Usability measures (cont.)

- Trade-offs in design options frequent
- Changes to interface in new version may
 - create consistency problems with previous version,
 - but ...
 - improve interface in other ways or
 - introduce new needed functionality



- Design alternatives
 - evaluated by designers and users
 - mockups / high-fidelity prototypes
- basic tradeoff : get feedback
 - early
 - less expensive in development process
 - vs more authentic interface evaluated



Usability motivations

- Many interfaces poorly designed
- across domains:



Life-critical systems

- Air traffic control, nuclear reactors, power utilities, police & fire dispatch systems
- High costs, reliability & effectiveness expected
- Lengthy training periods acceptable despite financial cost
 - error-free performance
 - avoid low frequency but high cost errors
- Subject satisfaction less issue
 - well motivated users



Usability motivations (cont.)



Industrial and commercial uses

- Banking, insurance, order entry, inventory management, reservation, billing, point-of-sales systems
- Ease of learning important to reduce training costs
- Speed and error rates relative to cost
- Speed of performance important
 - number of transactions
- Subjective satisfaction fairly important
 - limit operator burnout



Usability motivations (cont.)



Office, home, entertainment applications

- Word processing
- electronic mail
- computer conferencing
- video game systems
- educational packages, search engines
- mobile device
- etc.



- Ease of learning
- low error rates
- subjective satisfaction
- paramount
 - use often discretionary
 - competition fierce



- Infrequent use of some application
- → interfaces must be
 - intuitive
 - easy to use
 - online help important



- Choosing functionality difficult
- wide range user population
 - novice
 - expert
- Competition → need for low cost



Usability motivations (cont.)



Exploratory, creative, and cooperative systems

- Web browsing
- search engines
- artist toolkits
- architectural design
- software development
- music composition
- scientific modeling systems



- Collaborative work



- Benchmarks
 - hard to describe for
 - exploratory tasks
 - device users



computer should "vanish"

- → user absorbed in task domain



Usability motivations (cont.)



Social-technical systems

- Complex systems
- involve many people
- over long time periods



e.g.,

- Voting
- health support
- identity verification
- crime reporting



issues

- Trust
- privacy
- responsibility
- security



important!

- Verifiable sources
- status feedback



need

- Ease of learning for novices
- feedback to build trust



Administrators

- need tools to detect unusual patterns of usage



Universal Usability



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Physical abilities and physical workplaces

- *anthropometry*
 - Basic data about human dimensions



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no average user

- either compromises made
- or multiple versions of system created



- Physical measurement of human dimensions not enough
- take into account dynamic measures
- such as
 - reach
 - strength
 - speed



Universal Usability (cont.)

- Screen-brightness preferences vary substantially
- → knob to enable user control
- → account for variances of user population's sense perception



Vision

depth
contrast
color blindness
motion sensitivity



Touch

- keyboard and touchscreen sensitivity



Hearing

- audio clues must be distinct



workplace design

- help and hinder work performance



Universal Usability (cont.)



draft standard

- *Human Factors Engineering of Computer Workstations* (2002) lists these concerns:
 - Work-surface and display-support height
 - Clearance under work surface for legs
 - Work-surface width and depth
 - Adjustability of heights & angles for chairs & work surfaces
 - Posture—seating depth and angle; back-rest height and lumbar support
 - Availability of armrests, footrests, and palmrests



Universal Usability (cont.)



Cognitive and perceptual abilities

- Human ability to
 - interpret sensory input rapidly
 - initiate complex actions
- makes modern computer systems possible



Journal: *Ergonomics* Abstracts

- classification of human cognitive processes:
 - Long-term and semantic memory
 - Short-term and working memory
 - Problem solving and reasoning
 - Decision making and risk assessment
 - Language communication and comprehension
 - Search, imagery, and sensory memory
 - Learning, skill development, knowledge acquisition and concept attainment



Universal Usability (cont.)



also factors affecting perceptual and motor performance

- Arousal and vigilance
- Fatigue and sleep deprivation
- Perceptual (mental) load
- Knowledge of results and feedback
- Monotony and boredom
- Sensory deprivation
- Nutrition and diet
- Fear, anxiety, mood, and emotion
- Drugs, smoking, and alcohol
- Physiological rhythms



But note,

- in any application
 - background experience
 - knowledge in
 - task domain
 - interface domain
 - → play key roles in learning and performance



Universal Usability (cont.)



Personality differences

- no set taxonomy for identifying user personality types
- designers must be aware:
 - populations subdivided
 - → various responses to different stimuli



Myers-Briggs Type Indicator (MBTI)

- extroversion versus introversion
- sensing versus intuition
- perceptive versus judging
- feeling versus thinking



Universal Usability (cont.)



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Cultural and international diversity

- **Characters, numerals, special characters, and diacriticals**
- **Left-to-right versus right-to-left versus vertical input and reading**
- **Date and time formats**
- **Numeric and currency formats**
- **Weights and measures**
- **Telephone numbers and addresses**
- ...



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- **Names and titles (Mr., Ms., Mme.)**
- **Social-security, national identification, and passport numbers**
- **Capitalization and punctuation**
- **Sorting sequences**
- **Icons, buttons, colors**
- **Pluralization, grammar, spelling**
- **Etiquette, policies, tone, formality, metaphors**



Universal Usability (cont.)



Users with disabilities

- **plan early to accommodate users with disabilities**
 - **→ more cost efficient than adding on later**
- **businesses must comply with**
 - **"Americans With Disabilities" Act for some applications**



Elderly Users

- **Including elderly fairly easy**
 - **allow for variability within applications**
 - **settings for**
 - **sound**
 - **color**
 - **brightness**
 - **font sizes**
 - **etc.**



Goals for our profession

- **Potential research topics**
 - Reduce anxiety and fear of computer usage
 - Graceful Evolution
 - Specification and implementation of interaction
 - Direct manipulation
 - Input devices
 - Online assistance
 - Information exploration



Goals for our profession (cont.)

- **Provide tools, techniques, and knowledge for system implementers**
 - Rapid prototyping easy when using contemporary tools
 - Use general or self-determined guideline documents written for specific audiences
 - To refine systems, use feedback from individual or groups of users



Goals for our profession (cont.)

- **Raise computer consciousness of general public**
 - **Many novice users fearful due to experience with poor product design**
 - **Good designs help novices through these fears by being**
 - **clear**
 - **competent**
 - **nonthreatening**

