

CHAPTER 1: Usability of Interactive Systems

*Designing the User Interface:
Strategies for Effective Human-Computer Interaction*

Fifth Edition

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Introduction

- The Interdisciplinary Design Science of Human-Computer Interaction (HCI) combines knowledge and methods associated with professionals including:
 - Psychologists (incl. Experimental, Educational, Social and Industrial Psychologists)
 - Computer Scientists
 - Instructional and Graphic Designers
 - Technical Writers
 - Human Factors and Ergonomics Experts
 - Anthropologists and Sociologists

Introduction (continued)

- What are the Ramifications?
 - Success Stories: Microsoft, Linux, Amazon.com, Google
 - Competition: Firefox vs. Internet Explorer
 - Copyright Infringement Suits - Apple vs. Microsoft (Windows) and Napster vs. The music industry
 - Mergers: AOL and Time Warner
 - Corporate Takeovers: IBM's seizure of Lotus
 - Privacy and Security issues: identification theft, medical information, viruses, spam, pornography, national security

Introduction (continued)

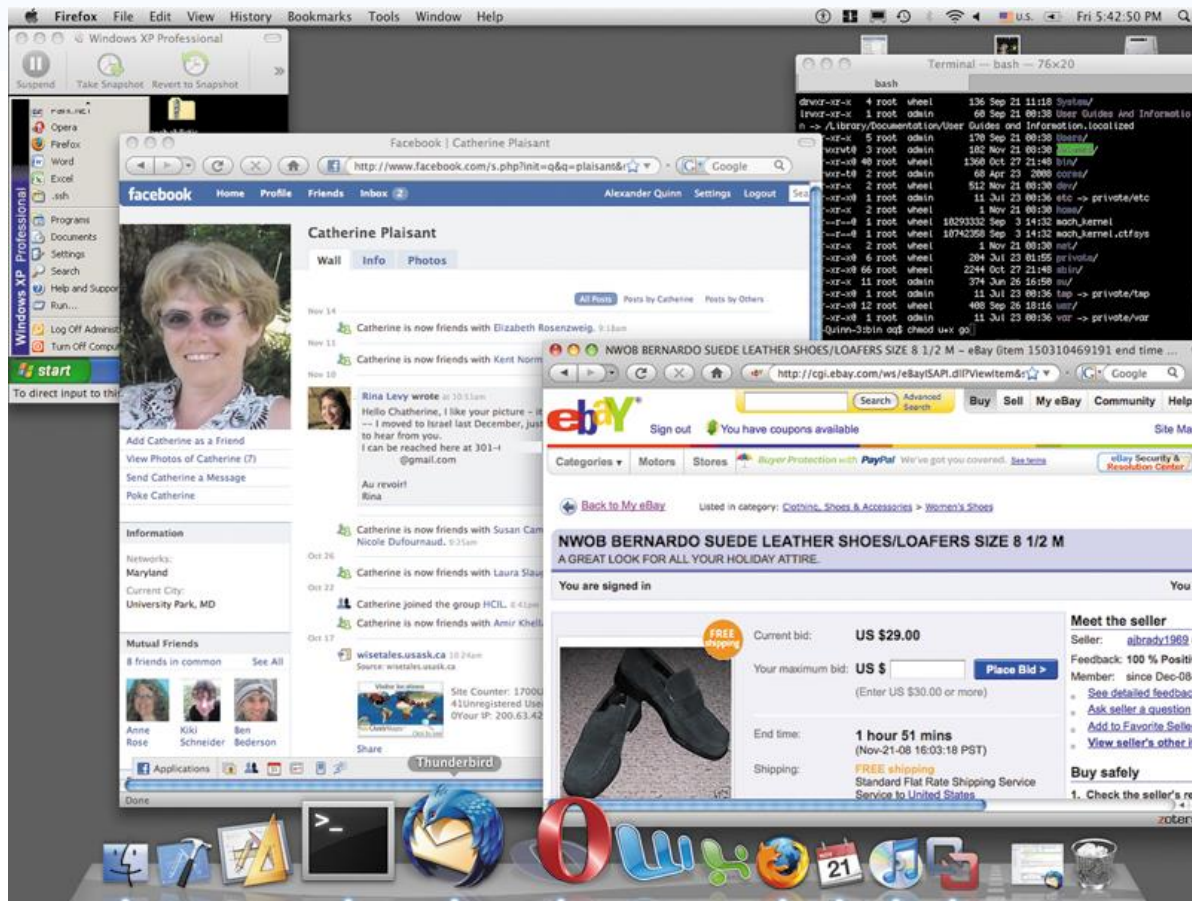
- Individual User Level
 - Routine processes: tax return preparation
 - Decision support: a doctor's diagnosis and treatment
 - Education and training: encyclopedias, drill-and-practice exercises, simulations
 - Leisure: music and sports information
 - User generated content: social networking web sites, photo and video share sites, user communities
 - Internet-enabled devices and communication

Introduction (continued)

- Communities
 - Business use: financial planning, publishing applications
 - Industries and professions: web resources for journals, and career opportunities
 - Family use: entertainment, games and communication
 - Globalization: language and culture

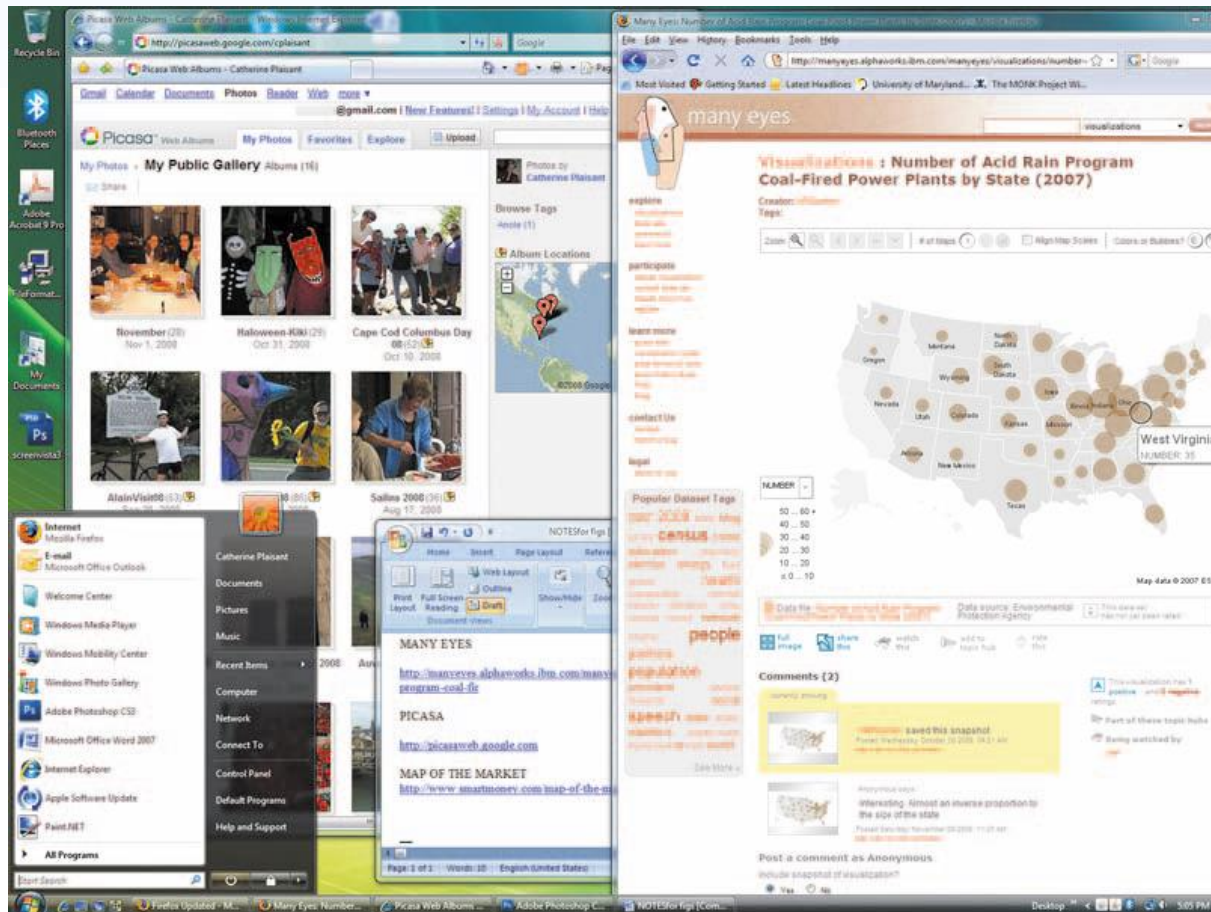
Introduction (continued)

- The new “look and feel” of computers (Mac)



Introduction (continued)

- The new “look and feel” of computers (Vista)



Introduction (concluded)

- And smaller devices doing more...



Book overview

- Chapter 1:
 - A broad overview of human-computer interaction from practitioner and research perspectives
- Chapter 2:
 - Guidelines, principles, and theories
- Chapters 3-4:
 - Managing design processes and evaluating designs
- Chapters 5-9:
 - Interaction styles
- Chapters 10-14:
 - Critical design decisions
- Afterword:
 - Societal and individual impacts of user interfaces

Usability requirements

- Synonyms for “user-friendly” in Microsoft Word 2002 are easy to use; accessible; comprehensible; intelligible; idiot proof; available; and ready
- But a “friend” also seeks to help and be valuable. A friend is not only understandable, but understands. A friend is reliable and doesn’t hurt. A friend is pleasant to be with.
- These measures are still subjective and vague, so a systematic process is necessary to develop usable systems for specific users in a specific context

Usability requirements (cont.)

- The *U.S. Human Engineering Design Criteria for Military Systems* (1999) states these 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
- Should improving the user's quality of life and the community also be objectives?
- Usability requires project management and careful attention to requirements analysis and testing for clearly defined objectives

Goals for requirements analysis

- **Ascertain the user's needs**
 - Determine what tasks and subtasks must be carried out
 - Include tasks which are only performed occasionally. Common tasks are easy to identify.
 - Functionality must match need or else users will reject or underutilize the product

Goals for requirements analysis

- **Ensure reliability**
 - Actions must function as specified
 - Database data displayed must reflect the actual database
 - Appease the user's sense of mistrust
 - The system should be available as often as possible
 - The system must not introduce errors
 - Ensure the user's privacy and data security by protecting against unwarranted access, destruction of data, and malicious tampering

Goals for requirements analysis

- **Promote standardization, integration, consistency, and portability**
 - *Standardization*: use pre-existing industry standards where they exist to aid learning and avoid errors (e.g. the W3C and ISO standards)
 - *Integration*: the product should be able to run across different software tools and packages (e.g. Unix)
 - *Consistency*:
 - compatibility across different product versions
 - compatibility with related paper and other non-computer based systems
 - use common action sequences, terms, units, colors, etc. within the program
 - *Portability*: allow for the user to convert data across multiple software and hardware environments

Goals for requirements analysis

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

Late or over budget products can create serious pressure within a company and potentially mean dissatisfied customers and loss of business to competitors



Usability measures

- Define the target user community and class of tasks associated with the interface
- Communities evolve and change (e.g. the interface to information services for the U.S. Library of Congress)
- 5 human factors central to community evaluation:
 - *Time to learn*
How long does it take for typical members of the community to learn relevant task?
 - *Speed of performance*
How long does it take to perform relevant benchmarks?
 - *Rate of errors by users*
How many and what kinds of errors are made during benchmark tasks?
 - *Retention over time*
Frequency of use and ease of learning help make for better user retention
 - *Subjective satisfaction*
Allow for user feedback via interviews, free-form comments and satisfaction scales

Usability measures (cont.)

- Trade-offs in design options frequently occur.
 - Changes to the interface in a new version may create consistency problems with the previous version, but the changes may improve the interface in other ways or introduce new needed functionality.
- Design alternatives can be evaluated by designers and users via mockups or high-fidelity prototypes.
 - The basic tradeoff is getting feedback early and perhaps less expensively in the development process versus having a more authentic interface evaluated.

Usability motivations

Many interfaces are poorly designed and this is true across domains:

- Life-critical systems
 - Air traffic control, nuclear reactors, power utilities, police & fire dispatch systems, medical equipment
 - High costs, reliability and effectiveness are expected
 - Length training periods are acceptable despite the financial cost to provide error-free performance and avoid the low frequency but high cost errors
 - Subject satisfaction is less an issue due to well motivated users

Usability motivations (cont.)

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

Usability motivations (cont.)

- Office, home, and entertainment applications
 - Word processing, electronic mail, computer conferencing, and video game systems, educational packages, search engines, mobile device, etc.
 - Ease of learning, low error rates, and subjective satisfaction are paramount due to use is often discretionary and competition fierce
 - Infrequent use of some applications means interfaces must be intuitive and easy to use online help is important
 - Choosing functionality is difficult because the population has a wide range of both novice and expert users
 - Competition cause the need for low cost
 - New games and gaming devices!
 - For example, Nintendo Wii



Usability motivations (cont.)

- Exploratory, creative, and cooperative systems
 - Web browsing, search engines, artist toolkits, architectural design, software development, music composition, and scientific modeling systems
 - Collaborative work
 - Benchmarks are hard to describe for exploratory tasks and device users
 - With these applications, the computer should be transparent so that the user can be absorbed in their task domain

Usability motivations (cont.)

- Social-technical systems
 - Complex systems that involve many people over long time periods
 - Voting, health support, identity verification, crime reporting
 - Trust, privacy, responsibility, and security are issues
 - Verifiable sources and status feedback are important
 - Ease of learning for novices and feedback to build trust
 - Administrators need tools to detect unusual patterns of usage

Universal Usability

- **Physical abilities and physical workplaces**
 - Basic data about human dimensions comes from research in *anthropometry*
 - 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

Universal Usability (cont.)

- Screen-brightness preferences vary substantially, designers customarily provide a knob to enable user control
- Account for variances of the user population's sense perception
- Vision: depth, contrast, color blindness, and motion sensitivity
- Touch: keyboard and touchscreen sensitivity
- Hearing: audio clues must be distinct
- Workplace design can both help and hinder work performance

Universal Usability (cont.)

- The standard *ANSI/HFES 100-2007 Human Factors Engineering of Computer Workstations* (2007) lists these concerns:
 - Work-surface and display-support height
 - Clearance under work surface for legs
 - Work-surface width and depth
 - Adjustability of heights and angles for chairs and 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
 - The human ability to interpret sensory input rapidly and to initiate complex actions makes modern computer systems possible
 - The journal *Ergonomics Abstracts* offers this 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.)

- They also suggest this set of 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 and knowledge in the task domain and the interface domain play key roles in learning and performance

Universal Usability (cont.)

- **Personality differences**
 - There is no set taxonomy for identifying user personality types
 - Designers must be aware that populations are subdivided and that these subdivisions have 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.)

- **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
 - 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 physical challenges**
 - Designers must plan early to accommodate users with disabilities
 - Early planning is more cost efficient than adding on later
 - Businesses must comply with the "Americans With Disabilities" Act for some applications
- **Older Adult Users**
 - Including the elderly is fairly easy
 - Designers should allow for variability within their applications via settings for sound, color, brightness, font sizes, etc. with less distracting animation

Universal Usability (concluded)

- Younger users



Goals for our profession

- **Potential research topics**
 - Reducing anxiety and fear of computer usage
 - Graceful evolution
 - Specification and implementation of interaction
 - Direct manipulation
 - Social media participation
 - Input devices
 - Online assistance
 - Information exploration

Goals for our profession (cont.)

- **Providing tools, techniques, and knowledge for system implementers**
 - Rapid prototyping is 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
- **Raising the computer consciousness of the general public**
 - Many novice users are fearful due to experience with poor product design
 - Good designs help novices through these fears by being clear, competent, and nonthreatening