Chapter 1

Usability of Interactive Systems

Introduction

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

Introduction

- What are the Ramifications?
  - Success Stories: Microsoft, Linux, Amazon.com, Google
  - Competition: Netscape vs. Internet Explorer
  - Privacy and Security issues: identification theft, medical information, viruses, spam, pornography, national security

Introduction

- 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

Introduction

- Communities
  - Business use: financial planning, publishing applications
  - Industries and professions: web resources and career opportunities
  - Family use: entertainment and communication

Book Overview

- Chapter 1:
  - A broad overview of human-computer interaction from practitioner and research perspectives
- Chapter 2:
  - Guidelines, principles, and theories
- Chapters 3-5:
  - Development processes and software tools
- Chapters 6-10:
  - Interaction styles
- Chapters 11-14:
  - Critical design decisions

Usability Requirements

- Every designer wants to build high-quality interfaces
  - Quality means features such as usability, usefulness, and universality
- Everyone want “user-friendly” interfaces, but what do they mean?
  - Synonyms for “user-friendly” in Microsoft Word 2002:
    - *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. And …
  - 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

- Usability requires project management and careful attention to requirements analysis and testing for clearly defined objectives
- Goals for requirements analysis
  1. Ascertain the users' needs.
  2. Ensure proper reliability.
  3. Promote appropriate standardization, integration, consistency, and portability.
  4. Complete projects on schedule and within budget.

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
  - Providing excessive functionality is also a danger because the complexity make implementation, learning and usage more difficult.

Goals for Requirements Analysis

- Ensure reliability
  - Actions must function as specified
  - Database data displayed must reflect the actual database
  - 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 and destruction of data

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, ISO, Apple, and Windows interface standards
  - *Integration*: the product should work with different software tools and packages
  - *Consistency*:
    - use common action sequences, terms, units, colors, etc. within the program
    - compatibility across different product versions
    - compatibility with related paper and other non-computer based systems
  - *Portability*: allow for the user to convert data and to share user interfaces 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

- Determining the target user community and set of tasks is the basis for establishing usability goals and measures.
- For each user and each task, precise measurable objectives guide the designer, evaluator, or manager.
- Communities evolve and change
  - e.g. a library information system

Usability Measures

- The ISO 9241 standard

  "Ergonomics requirements for office work with visual display terminals (VDTs)“ – a set of international standards for using computers, including hardware, visual display, and interaction guidelines

  - Usability
    - **The *effectiveness*, *efficiency*, and *satisfaction* with which specified users achieve specified goals in particular environments.**
    - Effectiveness
      - The accuracy and completeness with which specified users can achieve specified goals in particular environments.
    - Efficiency
      - The resources expended in relation to the accuracy and completeness of goals achieved.
    - Satisfaction
      - The comfort and acceptability of the work system to its users and other people affected by its use.

Usability Measures

- The following usability measures lead more directly to practical evaluation:
  1. *Time to learn*
     How long does it take for typical members of the community to learn actions relevant to a set of tasks?
  2. *Speed of performance*
     How long does it take to carry out the benchmark tasks?
  3. *Rate of errors by users*
     How many and what kinds of errors are made during benchmark tasks?
  4. *Retention over time*
     How well do users maintain their knowledge after an hour, a day, or a week? Frequency of use and ease of learning help make for better user retention
  5. *Subjective satisfaction*
     How much did users like using various aspects of the interface? The answer can be ascertained by interviews, free-form comments and satisfaction scales

Usability Measures

- Every designer like to succeed in every category, but trade-offs in design options frequently occur.
- Examples:
  - task-performance vs. time to learn
  - speed of performance vs. error rate
- Design alternatives can be evaluated by designers and users via mockups or high-fidelity prototypes.

Usability Motivations

- The interest in interface usability arises by looking at the poorly designed interfaces and the benefits of elegant interfaces. Interfaces can be seen in different domains:
- Life-critical systems
  - Air traffic control, nuclear reactors, police & fire dispatch systems, military operations, and medical instruments
  - High costs, reliability and effectiveness are expected
  - Lengthy training periods are acceptable despite the financial cost to provide error-free performance
  - Subjective satisfaction is less an issue due to well motivated users

Usability Motivations

- 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 of performance is important because of the number of transactions
  - Subjective satisfaction is fairly important to limit operator burnout
  - Retention is obtained by frequent use

Usability Motivations

- Office, home, and entertainment applications
  - Word processing, electronic mail, computer conferencing and video game systems, educational packages, search engines, mobile devices, etc.
  - Ease of learning, low error rates, and subjective satisfaction are very important because use is often discretionary and competition is intense
  - Infrequent use of some applications means interfaces must be intuitive, and comprehensible online help is important
  - Choosing functionality is difficult because the population has a wide range of both novice and expert users
    - A level-structured design is one approach (e.g., search engines)
  - Competition cause the need for low cost

Usability Motivations

- Exploratory, creative, and cooperative systems
  - Exploratory: Web browsing, search engines, simulation and business decision making
  - Creative: Artist toolkits, architectural design, software development, music composition, and scientific modeling systems
  - Collaborative: enable two or more people to work together, even if they are separated by time and space
  - These systems are difficult to design and evaluate because:
    - users may be knowledgeable in task domain but novices in the underlying computer concepts.
    - Benchmark tasks are more difficult to describe because of the exploratory nature of these applications.
  - The computer should "vanish" so that the user can be absorbed in their task domain

Usability Motivations

- Socio-technical systems
  - Complex systems that involve many people over long time periods
  - Voting, health support, identity verification, crime reporting
  - Trust, privacy, and security are issues
  - Ease of learning for novices and feedback to build trust
  - Administrators need tools to detect unusual patterns of usage and review procedures at different levels

Universal Usability

- Usable by all or most users
- Understanding the physical, intellectual and personality differences between users is vital for getting participation by broadest set of users
- Sometimes accommodating the needs of one group benefits other groups as well.

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
    - Examples
      - keyboard
      - display
  - Physical measurement of human dimensions are not enough, take into account dynamic measures such as reach, strength or speed

Universal Usability

- Physical abilities and physical workplaces
  - Differences in perceptual abilities
    - Vision: depth, contrast, color blindness, and motion sensitivity
    - Touch: keyboard and touch-screen sensitivity
    - Hearing: audio clues must be distinct
  - Workplace design can both help and hinder work performance
    - For an individual
    - For multiple workstations

Universal Usability

- Physical abilities and physical workplaces
  - The 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 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

- Cultural and international diversity
  - Accommodating cultural and international differences will increases the market share of interactive products.
  - User interface design concerns for internationalization:
    - Characters, numerals, special characters
    - 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
    - Social-security, national identification, and passport numbers
    - Capitalization and punctuation
    - Sorting sequences
    - Icons, buttons, colors
    - Etiquette, policies, tone, formality

Universal Usability

- Users with disabilities
  - Designers must plan early to accommodate users with disabilities
    - Vision-impaired
    - hearing-impaired
    - mobility-impaired
- Elderly Users
  - Including the elderly is fairly easy; designers should allow for variability within their applications via settings for sound, color, brightness, font sizes, etc.
  - If elder people can use the technology easily, we have more opportunities of knowing about their experiences

Universal Usability

- Children
  - Designers need attention to their limitations.
  - They may not always do mouse-dragging, double-clicking or pointing on small targets.
  - Usual instructions and error messages might not be effective
  - Parental control over dangerous content
- Accommodating hardware/software diversity
  - Internet interaction on high-speed (broadband) and slower (dial-up) connections
  - Access to web services from large displays and small mobile devices
  - Easy or automatic conversion to multiple languages

Skipped Sections

The following sections have been skipped:

- 1.5.2: Cognitive and perceptual abilities
- 1.5.3: Personality differences

- 1.6 Goals for Our Profession