Designing the User Interface

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Chapter 1

Usability of Interactive Systems

Introduction

Human-Computer Interaction (HCI)

- Interdisciplinary design science
- combines knowledge and methods associated with professionals including:
  - Psychologists (incl. Experimental, Educational, 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: *Netscape 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

Introduction (continued)

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

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
- Afterword:
  - Societal and individual impacts of technology

Usability requirements

- Synonyms for “user-friendly”
  - easy to use; accessible; comprehensible; intelligible; idiot proof; available; and ready
- friend
  - seeks to help and be valuable
  - not only understandable, but understands
  - reliable and doesn’t hurt
  - pleasant to be with
- measures are subjective and vague
  - need a systematic process to develop usable systems for specific users in a specific context

Usability requirements (cont.)

- The U.S. Military Standard for Human Engineering Design Criteria (1999):
  - 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
- Improve the quality of life for both the user and the community
- 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:**

1. **Time to learn**
   How long does it take for typical members of the community to learn relevant task?
2. **Speed of performance**
   How long does it take to perform relevant benchmarks?
3. **Rate of errors by users**
   How many and what kinds of errors are made during benchmark tasks?
4. **Retention over time**
   Frequency of use and ease of learning help make for better user retention
5. **Subjective satisfaction**
   Allow for user feedback via interviews, free-form comments and satisfaction scales

Usability measures (cont.)

- Trade-offs in design
- Changes to the interface in a new version may create consistency problems with the previous version
  - changes may improve the interface in other ways or introduce new needed functionality.
- Design alternatives evaluated by designers and users via mockups or high-fidelity prototypes
- The basic tradeoff
  - get feedback early, 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
  - 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

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 "vanish" 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 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 (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.)

- 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
- key roles in learning and performance
  - background experience and knowledge in the task domain and the interface domain

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 disabilities**
  - 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
- **Elderly Users**
  - Including the elderly is fairly ease, designers should allow for variability within their applications via settings for sound, color, brightness, font sizes, etc.

Goals for our profession

- Potential research topics
  - Reducing 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.)

- **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

Brief History of HCI Technology

- View from the “computer” side of HCI
- Basic interactions (WYSIWYG)
  - Direct manipulation
  - Mouse
  - Windows
- Application Types
  - Drawing programs
  - Text editing
  - Spreadsheets
  - Hypertext (documents are linked to related documents)
  - Computer aided design (CAD)
  - Video Games

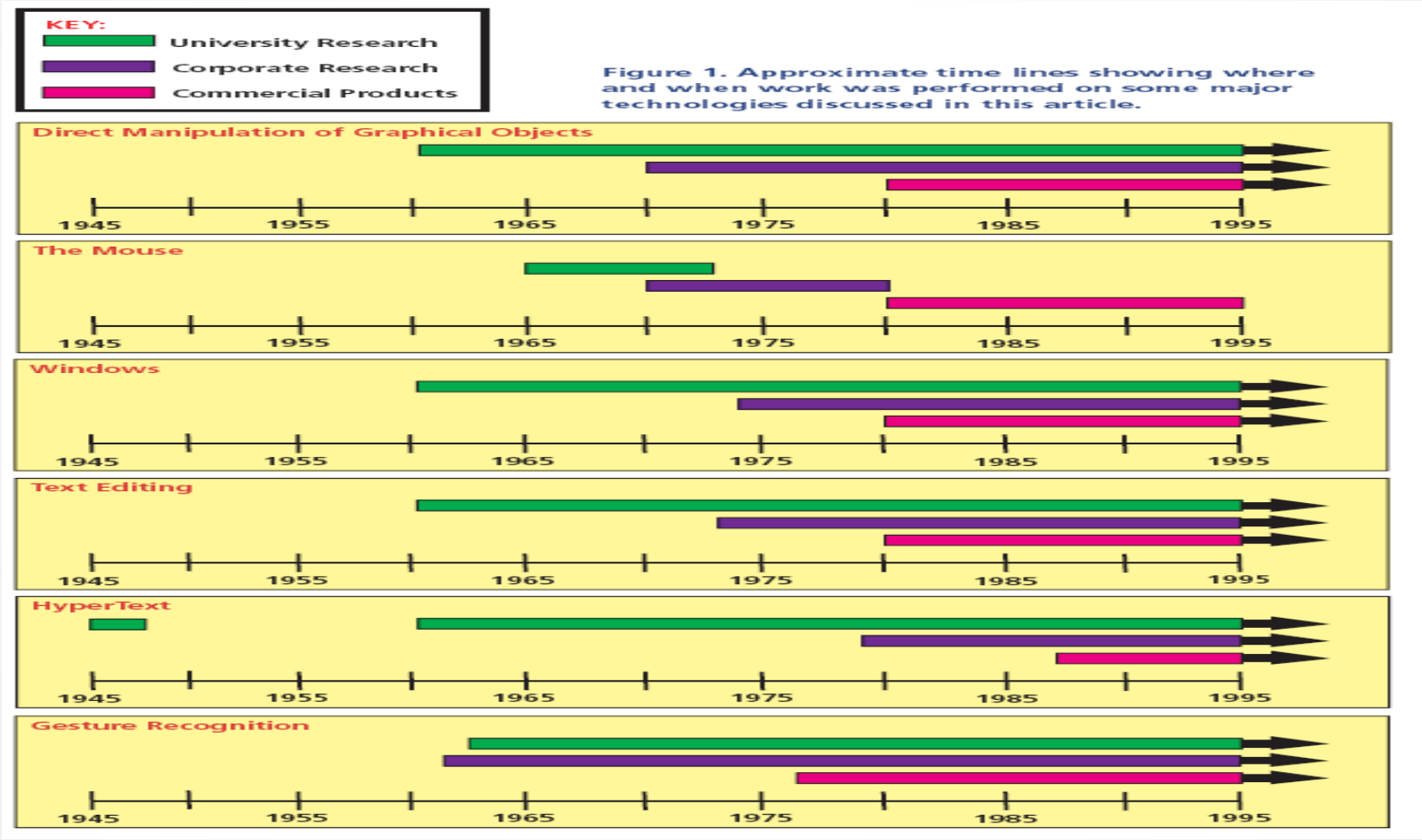

Figure 1. Approximate time lines showing where and when work was performed on some major technologies discussed in this article.

Brief History (continued)

- Up and Coming areas
  - Gesture recognition
    - Light-pen-based systems
    - Multi-media
    - 3-D
    - Virtual Reality and “Augmented Reality”
    - Computer Supported Cooperative Work (CSCW)
    - Natural language and speech

Brief History (continued)

- Software Tools and Architecture
  - UIMs and Toolkits (software libraries and tools that support creating interfaces by writing code)
  - Interface Builders (interactive tools that allow interfaces composed of widgets such as buttons, menus and scrollbars to be placed using a mouse)
  - Component architecture
    - Create interfaces by connecting separately written components