

Augmented Reality II

User Interfaces:

Human Factors, Theories, Principles, Guidelines

Gudrun Klinker

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Outline

- Motivation: AR as a novel User Interface
- Introduction to “traditional UI design”
 - Human factors
 - Theories
 - Principles
 - Guidelines

Literature

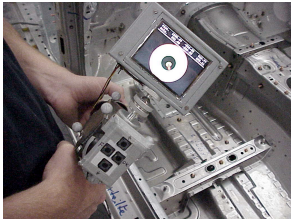
- Ben Shneiderman, “Designing the User Interface, Strategies for Effective Human-Computer Interaction”, Addison Wesley.
(Chapters 1,2)

Motivation

- Augmented Reality as a new, three-dimensional user interface supporting direct manipulation.
- How can it be integrated / used in real applications?
- What are the theories, principles and guidelines of creating good user interfaces?

Motivation

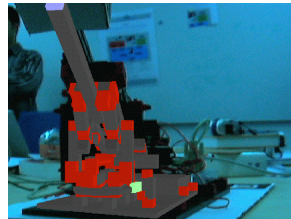
- Examples -



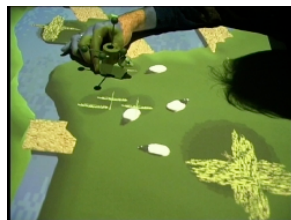
- PAARTI (stud welding)
 - heARts (Minimally invasive surgery)



- Fatamorgana (car design)



- FixIT (diagnosis of machine malfunctions)
 - STARS (plant maintenancs)



- SHEEP (collaborative process control)
 - CAR (rapid prototyping of UI functionality)

1. Human Factors

1. Human Factors

- Goals of System Engineering
- Goals of UI Design
- Motivations for Human Factors in Design
- Human Diversity
- Goals of Human Factors Research

1.1 Goals of System Engineering

- Achieve proper functionality (task analysis)
- Reliability, availability, security, and data integrity
- Standardization, integration, consistency, portability
- Schedules and budgets
 - proper attention to human factors principles and rigorous testing often leads to reduced cost and rapid development

1.2 Goals of UI Design

- Careful determination of the user community
- Measurable human factors
 - Time to learn
 - Speed of performance
 - Rate of errors by users
 - Retention over time (1 hour, 1 day, 1 week)
 - Subjective satisfaction
- Forced trade-offs

1.3 Motivations for Human Factors

- Many system UIs are poorly designed.
- Observations in four application areas:
 - Life-critical systems
 - Industrial, commercial use
 - Office, home, and entertainment
 - Exploratory, creative, and cooperative use

1.3 Motivations for Human Factors

- Life-Critical Systems -

- High costs ok
- High reliability and effectiveness
- Lengthy training periods ok
- Rapid, error-free performance (even under stress)
- Subjective satisfaction not important
- Retention gained by frequent use and training

1.3 Motivations for Human Factors

- Industrial, Commercial Use -

- Lower cost, if possible
- Reliability can be sacrificed
- Only easy (cheap) training
- Speed of performance vs. error rates: keep cost low
- Subjective satisfaction modestly important
- Retention obtained by frequent use
- Speed of performance **CENTRAL!**
(High volume of database transactions)
- Beware of operator fatigue

1.3 Motivations for Human Factors

- Office, Home, Entertainment -

- Ease of learning very important
- Low error rates very important
- Subjective satisfaction very important
- Retention not so important
- Right functionality difficult to achieve
- Low cost important

1.3 Motivations for Human Factors

- Exploratory, Creative, Cooperative -

- System difficult to design and to evaluate because
 - Novel users
 - High motivation
 - High expectations
 - Unknown functionality
- Computer should vanish from the users' minds as they focus on a task
- --> Direct manipulation

1.4 Human Diversity

- Physical abilities, physical workspace
- Cognitive and perceptual abilities
- Personality differences
- Cultural and international differences
- Users with disabilities
- Elderly users

1.4 Human Diversity

- Physical abilities, workspace -

- Anthropometry (“average user”)
- Dynamic actions (e.g. reach distance, typing speed)
- Perceptual abilities
 - Vision
 - color, color blindness
 - peripheral vs. fovea
 - sensitivity to flicker, contrast, motion glare, visual fatigue, depth perception
 - Touch
 - Hearing

Ergonomics

1.4 Human Diversity

- Cognitive and Perceptual Abilities -

- Cognitive processes
 - Short-term memory
 - Long-term memory
 - Problem solving
 - Decision making
 - Attention, scope of concern
 - Search, scanning
 - Time perception
- Factors affecting performance
 - Arousal, vigilance
 - Fatigue
 - Perceptual (mental) load
 - Knowledge of results
 - Monotony, boredom
 - Sensory deprivation
 - Sleep deprivation
 - Anxiety, fear
 - Isolation
 - Aging
 - Drugs, alcohol

1.4 Human Diversity

- Personality differences -

- Men vs. women
- MBTI (Myers-Briggs Type Indicator)
 - Extroversion vs. introversion
 - Sensing vs. intuition
 - Perceptive vs. judging
 - Feeling vs. thinking
- Relationships between
 - Professions and personality types
 - People of different personality types

1.4 Human Diversity

- Personality Differences -

- Psychological scales
 - Risk taking vs. risk avoidance
 - Internal vs. external locus of control
 - Reflective vs. impulsive behavior
 - Convergent vs. divergent thinking
 - High vs. low anxiety
 - Tolerance for stress
 - Tolerance for ambiguity, motivation, compulsiveness
 - Field dependence vs. independence
 - Assertive vs. passive personality
 - Left- vs. right-brain orientation

1.4 Human Diversity

-Cultural and International Differences-

- Characters, numerals, special characters
- Left-to-right vs. right-to-left input, horizontal vs. vertical
- Formats (time, currency, weights, tel-nr., ...)
- Orthography
- Sorting sequences
- Icons, buttons, colors
- Etiquette, policies, tone, formality, metaphors

1.4 Human Diversity

- Users with Disabilities -

- Impairments (hearing, vision, speech, body control)
- Learning disabilities
- Special devices
- “Computer curbcuts”

1.4 Human Diversity

- Elderly Users -

- Diminishing
 - Average visual and auditory acuity
(visual acuity, dark adaptation, accommodation, contrast sensitivity, peripheral vision)
 - Average strength, speed of response
 - Some kinds of memory function
 - Perceptual flexibility
 - “Stimulus encoding”
- Increasing
 - Difficulty in acquisition of complex mental skills

1.5 Goals of Human Factors Research

- Influence academic and industrial researchers
- Provide tools, techniques, and knowledge for systems implementors
- Raise the computer consciousness of the general public

1.5 Goals of Human Factors Research

Fruitful research directions

- Reduced anxiety and fear of compute usage
- Graceful evolution
- Specification and implementation of interaction
- Direct manipulation
- Input devices
- Online assistance
- Information exploration

1.5 Goals of Human Factors Research

- Encourage users to translate their internal fears into outraged action.
- Users should not feel
 - guilty
 - inadequate

