Human Factors Research and the Human-Computer Interface

Technology and the Customer Interface

Guest Lecture by Katy Börner
Overview

1. Introduction of myself 😊
2. Human Factors Research and the Human-Computer Interface
3. Evolution of Computers and their Interfaces
AkuVis (Interactive Visualization of Acoustic Data, 1997/98)

Purpose:
3D visualization and interactive audio-visual exploration of acoustic noise data collected by the German TÜV used for governmental decisions about noise protection regulations for new streets, industrial areas etc.

Technology: iDesk
Mode: Single User

VegoWelt (Virtual Lego World, 1998/99)

Purpose:
Uses a children's playroom scenario for demonstrating and evaluating the support of manipulation activity.

Technology: CAVE
Mode: Single User

LVis (Digital Library Visualizer, 1999/2000)

Purpose:
Aims at the support of the navigation through complex information spaces.

Technology: CAVE
Mode: Single User

http://ella.slis.indiana.edu/~katy/InfoVis/
**iUniverse** (Collab. Info. Universe for IU, 2000/01)

**Purpose:**
Aims at the design and evaluation of collaborative 3D online ‘Learning Environments’ for IU faculty.

**Technology:** Active Worlds, Desktop

**Mode:** Multiple User

http://ella.slis.indiana.edu/~katy/iUni/
2. Human Factors Research and the Human-Computer Interface

"Human Factors is a body of knowledge about human limitations, human abilities, and other human characteristics that are relevant to design."

"Human Factors Engineering is the application of human factors information to the design of tools, machines, systems, tasks, jobs, and environments for safe, comfortable, and effective human use."

"Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."

(Source: ACM SIGCHI Curricula for Human-Computer Interaction, 1992, p. 5)
History of UI
Punctuated Equilibrium

1960’s Batch
1970’s Command Line
1980-90’s GUI
2000? Beyond-WIMP

Each paradigm shift led to large increase in user base

(Source: George G. Robertson, OZCHI, 1998)
Match Human Capabilities

(Source: George G. Robertson, OZCHI, 1998)
UI Limitations

Failure to use Human Abilities

Limited Vision (Flat, 2D)

No Speech

No Gestures

Limited Audio

One Hand Tied Behind Back

Limited Tactile

(Source: George G. Robertson, OZCHI, 1998)
Leverage Human Capabilities

Understand complexity
New classes of tasks
Less effort

(Source: George G. Robertson, OZCHI, 1998)
Design User Interfaces that are

- **Multimodal:** use communication skills
  We use multiple modalities to communicate

- **Perceptive:** aware of user
  Input to computer: use human motor skills

- **Perceptual:** use many human abilities
  Perception, cognition, motor, communication

(Source: George G. Robertson, OZCHI, 1998)
How?

1. User & Task Analysis
2. Interface Design using rapid prototyping & user feedback
3. Usability testing. Do not rely solely on intuition. Test for usability!

*Involve user during entire design process!*
User Analysis (I)

To learn about users' reality, you need to get out and meet them, work with them, involve them in helping you to understand their:

- needs for information.
- ways of thinking about, grouping, and organizing information.
- expectations about your site.
- levels of knowledge about the subject matter.
- levels of experience with the Web and similar types of sites.

(Source: Collecting Data From Users
User Analysis (II)

Techniques for Gathering Data From Users:

- Early usability tests.
- Contextual interviews.
- Online surveys.
- Individual interviews.
- Focus groups.
- Card sorting.

(Source: Collecting Data From Users
Task Analysis (I)

Task = what the user is trying to accomplish (requires understanding the task domain and job goals).

Analysis = systematic approach to understanding tasks.

Success if result is usable system that is easy to learn, use, efficient, pleasant, ...

The system must match the users' tasks!
Task Analysis (II)

Where is TA used?

1. Development of requirements - make sure required functionality is there.
2. UI design and evaluation - choosing benchmark tasks for usability testing / usage scenarios for interface design / find problems in current design
3. Follow-up after installation - compare systems / problems in new system
Task Analysis (III)

Collecting Task Data

- Observation of user behavior - videotape / think aloud
- Critical incidents - informative episodes, accidents, failures, errors
- Questionnaires
- Structured interviews - with domain experts and users (do unstructured interviews first to get good questions)
- Interface surveys - collect information about existing UI
Task Analysis (IV)

General Questions

- What tasks are desired?
- How are the tasks learned?
- Where are the tasks performed?
- What's the relationship between user and data?
- What other tools does the user have?
- How do the users communicate with each other?
- How often does the user perform the tasks?
- What are the time constraints on the tasks?
- What happens when things go wrong?
Task Analysis (V)

Representing the Task Structure to make bottlenecks, inconsistencies, high workloads visible.

Use sequence diagrams (Flowcharts), Timeline Analysis, Hierarchical Task Analysis to make clear:

- What the user need to know.
- What the user has to do (actions, activities).
- What the user sees & interacts with.
Book Tip

John Wiley & Sons
Interface Design (I)

Based on user and task analysis ...

1. **Design the functional model:** define application model that facilitates user goals.

2. **Design the presentations:** visual representation of the actions an user can take.

3. **Design the interactive porthole:** organize info to fit on a screen.

4. **Design the actions:** actual techniques for manipulating info.
Interface Design (II)

Iterative Design - dominant engineering paradigm.
Interface Design (III)

Waterfall Model

1. Requirements
2. Analysis
3. Design
4. Coding
5. Testing
6. Maintenance
Interface Design (IV)

Rapid Prototyping

- sometimes combined with waterfall model
- prototyping leads to a more informed analysis
Interface Design (V)

Star Lifecycle
- no emphasis on phase order
- developed from actual practice amongst HCI designers
- evaluation is relevant at all stages
10 Usability Heuristics

1. Visibility of system status
2. Match between system and the real world
3. User control and freedom
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation

Usability Testing (I)

Evaluation - getting feedback of your design.

**Important points:**

- Characteristics of the users: beginners - experts - casual users
- Tasks: fixed tasks - user activities
- Environment: laboratory - field study
- Product: prototype - full product
Usability Testing (II)

Usability metrics used in evaluation:

- throughput - how many tasks/errors occur with an expert user? recovery time from errors
- completion time for tasks
- flexibility - can system be extended? how does it interact with the user?
- learnability - effort/time to achieve a given level of user performance
- attitude - does system create a positive attitude in users?
- time spent with documentation
Usability Testing (III)

Evaluation in the Life Cycle

**Early stages**
- Predict usability
- Check your understanding
- Test out ideas

**Later stages**
- Identify difficulties
- Improve product
Usability Testing (IV)

Evaluation Methods:
- Observing and monitoring performance
- Collecting the users opinions
- Experiments and benchmarks
- Interpretive evaluation
- Predictive evaluation
Usability Testing (V)

Methods vs. reasons: XX very likely choice, xx less likely, -- no use

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<th>Collecting the users opinions</th>
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Book Tip

3. Evolution of Computers

... from

- A mathematical engine.
- A data/information engine in administrative systems.
- A personalized tool to support the competence of a skilled worker, as an autonomous agent capable of learning, helping and giving advise.

into

- A mediator of human-to-human interaction.

(Source: Holmström & Jakobsson, 2001)
3-D Virtual Environments

- Natural, multi-perceptual interaction engagement - spatial sound, animation, video, ... (Brill, 1993).
- Exploitation of spatial metaphors - spatial maps that ease navigation can be build more easily.
- Presence (Barfield & Weghorst, 1993) & Telepresence (Steuer, 1995; Biocca, 1995).
- Sophisticated self representation (avatars wave, dance, ..., interact).
- Change of perspective - avatar view or third person view (Loftin, et al., 1993; Dede, et al., 1996)
Real context of interaction. Environment supports talk, triggers discussion.

Shared awareness promotes informal communication - brief, unplanned, frequent (Kraut et al., 1988; Whittaker et al., 1994).

Abstract concept representation (Byrne, 1996; Winn, 1993).

Physical proximity is fundamental to structuring and visualizing a semantic space for informal communication and social construction of knowledge (Chen, 2000).

Bots.

User logs.
3-D Online Browser Systems

- Community Place [www.community-place.com](http://www.community-place.com)
- Blaxxun's online community client-server architecture [www.blaxxun.com/community](http://www.blaxxun.com/community)
Community Place

- Business Solutions
- Educational Uses (Mud Bugs)
- Research and Development Applications
Blaxxun

- Entertainment (Cybertown)
- E-Commerce
- Business (Advipolis, Virtual Releight)
VW Platform

NYU Interactive Telecommunications Program: Explorers of the Ancient World: Egypt

Fred Hutchinson Cancer Research Center: Social Support for Cancer Patients
Active Worlds
iUniverse: Creating a Collaborative Information Universe for IU

L578 User Interface Design Class at SLIS, IUB used Active Worlds Technology and offered “Design Deal” to interested IU faculty.
(Source: http://ella.slis.indiana.edu/~katy/iUni/)

Advantages:
3D, collaboration, multi-media, space metaphor, 24/7
Send in a **project specification** that contains:

- Title of the project.
- Name of main contact person.
- Description of learning content & objectives in lay terms (what skills physical or cognitive are required).
- Explanation of why 3D is required/advantageous.
- A vision of how the 3D world should look like and a short story of what visitors will experience.
- A list of all material (text, images, 3D objects, audio files) that can be used to design the environment.
- Number of users that will potentially use this environment in the next 2 years.

And we may build this virtual environment for you!
Current Projects:

**Quest Atlantis - Educational theme park for the Boys & Girls Club in BL**
Client: Sasha Barab, School of Education
Designers: Mark Dial & Hakan Tuzun

**Natural Disaster Area & Science House**
Client: Bill Harwood, School of Education
Designers: Maggie Swan & Kent Holaday

**Virtual Collaboration Area**
Client: Alan Dennis, Kelley School of Business
Designers: Tim Bowman & Randy Fisher

**Art Cafe**
Client: Lilly Lu, School of Education
Designers: Symiaw Lin & Lilly Lu & Gertrud Peters
Development of iUni

Map of iUni  10/09/2000
iUni Today
Go ΨΗΙ !
Questions?