Overview

• Direct Manipulation
• Information Visualization
• Programming by demonstration
• Virtual and Augmented Reality
• Tangible “real world” interfaces

What We Wanted To Learn?

Human Factors  Systems  Computers (tools)

Analyze  Design  Build  Test
Theories, principles, methodologies, guidelines, tools...

Human-Computer Interfaces

Where We Are?

• The Background Knowledge (HIP, Java)
• From idea to product: The process
  – Design
  – Programming
  – Evaluation
    • Formal analysis
    • Heuristics and Walkthrough
    • User Studies
  – Extended Interface
Where We Are?

- Types of the “modern” interfaces
  - Hypertext and WWW
  - Menus and Form Fillin
  - GUI and Widgets
  - Adaptive Interfaces
  - Mobile and Ubiquitous Interfaces
- Trends for the future
  - Direct Manipulation
  - Virtual and Augmented Reality
  - Tangible Interfaces

Why Do We Need DM?

Positive feelings associated with good user interfaces:
- Mastery of the interface
- Competence in performing tasks
- Ease in learning the system originally and in assimilating advanced features
- Confidence in the capacity to retain mastery over time
- Enjoyment in using the system
- Eagerness to show off the system to novices
- Desire to explore more powerful aspects of the system

Direct Manipulation

- No interface: Batch processing
- Command/Dialogue Interface
- Graphical User Interface (GUI)
- NL and Speech
- Direct manipulation Interface
- Virtual reality
- Gestures

Direct vs. Indirect Manipulation

- How do people interact in the process of work? Building a log house.
  - A subject needs to cut trees to build a log house
  - using other humans and tools
    - No interaction - a set of orders
      - Simple task or expert workers
    - Interactive supervision (giving commands)
    - Do the work yourself using powerful tools (direct manipulation with a chainsaw :)
Examples of DM Systems

- Command line vs. display editors and word processors
- Spreadsheet
- Spatial data management
- Video games
- Computer-aided design
- Office automation
- Other examples

Early Days of DM: Text Editor

- Old text editors - command based
  - Remove lines from 3 to 5:
    \[3,5r\]
  - Insert Direct before Manipulation
    \[/Manipulation/\text{Direct Manipulation/}i\]
- Display editor (XEROX Star, Lisa, Mac)
  - Move cursor with arrow keys or mouse
  - Use key combination as commands

Command Line vs. Display Editors

- Training times with display editors are much less than line editors
- Display editors are generally more flexible and powerful
- WYSIWYG word processors has introduced a lot of new important features

Features of DM Interface

- Display full page of text (working field)
- Use WYSIWYG form as much as possible
- Show cursor (working area)
- Control cursor by natural means
- Buttons for actions
- Immediate feedback and action response
- Undo is important
From Display Editor to Direct Manipulation

- Understand how display editor differs from command-line editor
- Apply this difference to other application areas
  - Other kinds of “editors”
  - Operating Systems Shells
  - Calculations
  - Data manipulations
  - Games

DM Editors

- Command-based interfaces
  - Command-based editors
- Direct Manipulation Interfaces
  - Graphics Editor
  - Slide Editor
  - CAD
  - Publishing Programs

DM for Information Retrieval

- Command-based interfaces
  - Query - search results
- Direct Manipulation Interfaces
  - Stanford DM search

Direct Manipulation for Information Exploration

- Let the user explore information NOT by writing queries (commands) and passively looking at the results returned, but by...
  - Re-sorting by different parameters (year, author…)
  - Attribute Exploration
  - Exploring keyword dependencies
    - VIBE, LyberWorld
    - Exploring several ways to look at the same results graphically
    - ENVISION, TableLens
Direct Manipulation for Information Exploration

- Example - starfield display in FilmFinder
  - Formulating queries, searching, and exploration of results are fused together

Operating Systems Shells

- Command-based interfaces
  - UNIX Shells
- Direct Manipulation Interfaces
  - Mac OS, Windows

Calculations

- Command-based interfaces
  - Mathematica
- Direct Manipulation Interfaces
  - Spreadsheets

Games

- Command-based interfaces
  - Adventure
  - Lunar Landing
- Direct Manipulation Interfaces
## Data manipulations

- Command-based interfaces
- Direct Manipulation Interfaces

## Programming by Demonstration

- What could be an analog of direct manipulation for programming?
- Programming - writing sequenced of commands
- Direct Manipulation - ?

## Direct-Manipulation Programming

- Visual representations of information make direct-manipulation programming possible in some domains
- Demonstrational programming is when users create macros by simply doing their tasks
- The five challenges of programming in the user interface:
  - Sufficient computational generality
  - Access to the appropriate data structures and operators
  - Ease in programming and editing programs
  - Simplicity in invocation and assignment of arguments
  - Low risk

## Problems with DM

- Spatial or visual representations can be too spread out
- High-level flowcharts and database-schema can become confusing
- Designs may force valuable information out of the screen
- Users must learn the graphical representations
- The visual representation may be misleading
- Typing commands with the keyboard may be faster
**Benefits of DM**

- Novices learn quickly
- Experts work rapidly
- Intermittent users can retain concepts
- Error messages are rarely needed
- Users see if their actions are furthering their goals
- Users experience less anxiety
- Users gain confidence and mastery

**Virtual Environments**

- Virtual reality
- Augmented reality
- Situational awareness shows information about the real world that surrounds you by tracking the movements in a computer model

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**Optical See-Through HMD**

**Video see-through HMD (closed-view)**
Main Usages of AR

- Visualization
- Situated documentaries
- Interface to intelligent environment
- Cooperative work through "remote eye"

From Ubiquitous to Tangible Interfaces

- Integrating real and virtual world
- New input ways
  - Gestures, image recognition
- New devices
  - Mobile tangible devices
- New interfaces
  - Tangible Interfaces