



Lecture 4 – Models and Metaphors

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CS147 - Introduction to Human-Computer
Interaction Design

Computer Science Department

Stanford University

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Learning Goals

- Understand the use of metaphors in designing interfaces and be able to choose them appropriately
- Understand the need for a clear conceptual model in interface design and be able to analyze and create appropriate models for specific applications

Conceptual Models

- In interacting with any system (software or others), a person has a concept of what the system is: what its components are, what properties they have, and what interactions they can enter into. This conceptual model underlies the more specific aspects of interface, such as screen representations and command structures.

Metaphors

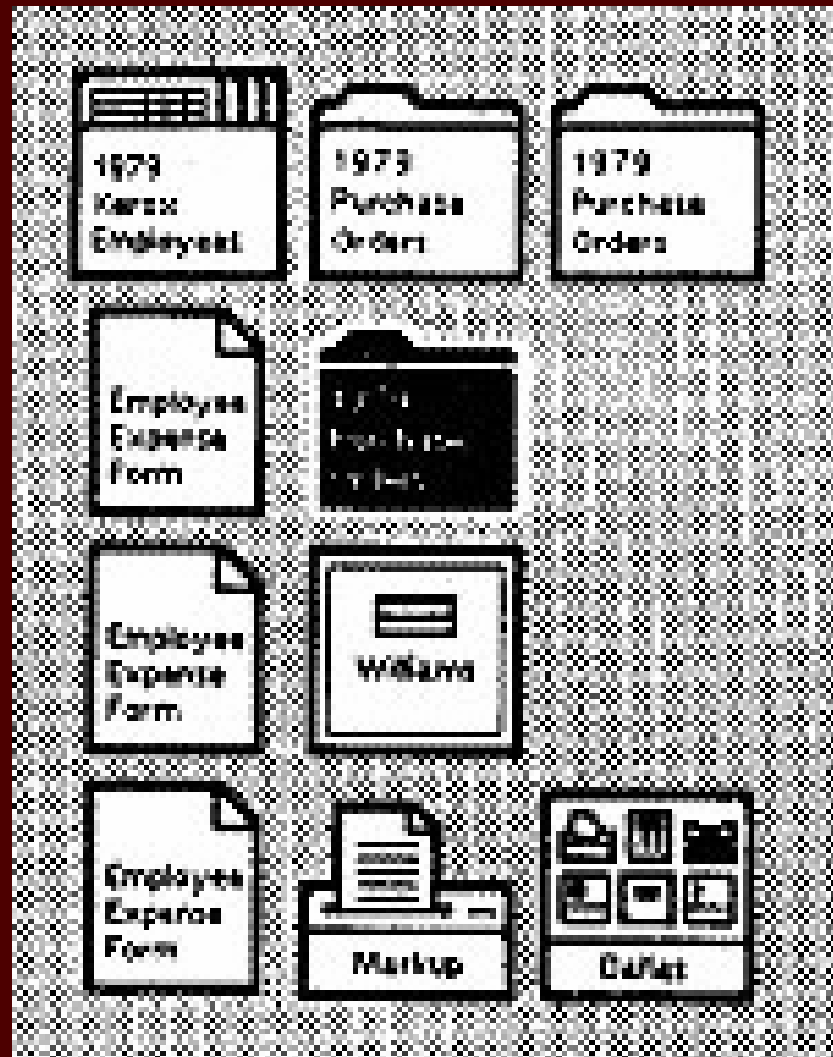
- A key issue in software design is to make the model as clear and comprehensible as possible, and to relate it appropriately to the person's models based on prior experience with other systems and aspects of ordinary life.
- Metaphors can help the designer communicate the mental model based on the user's prior understanding.

Three Paradigms [Cooper]

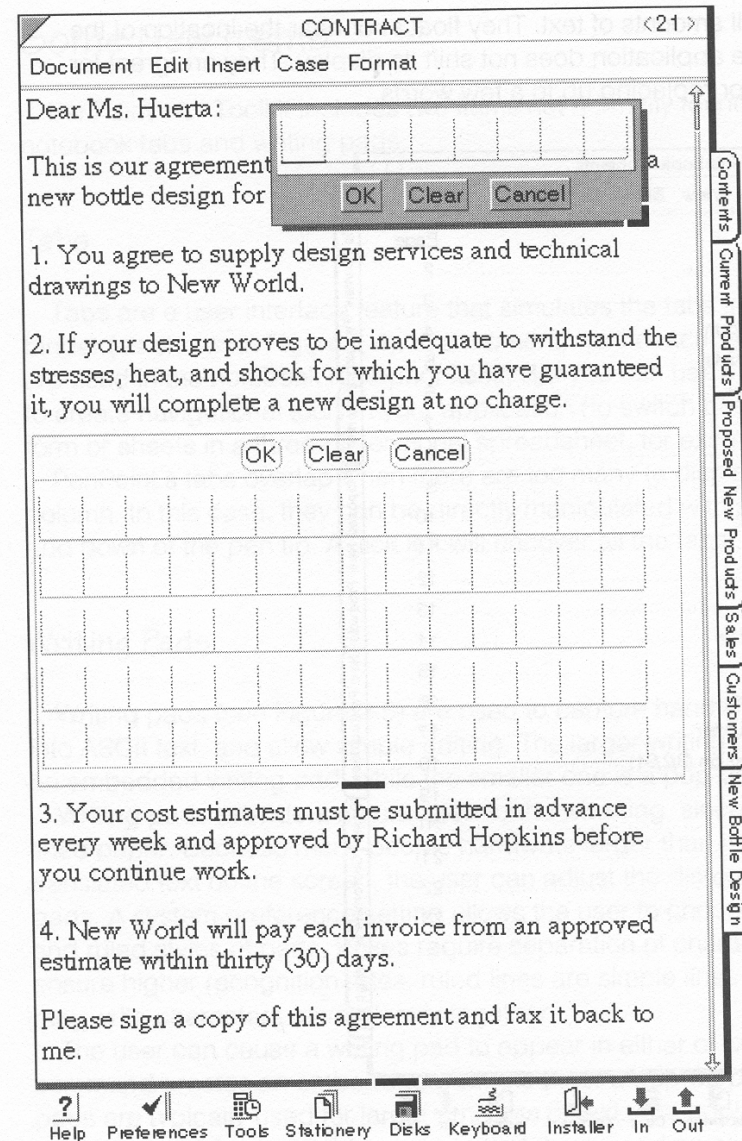
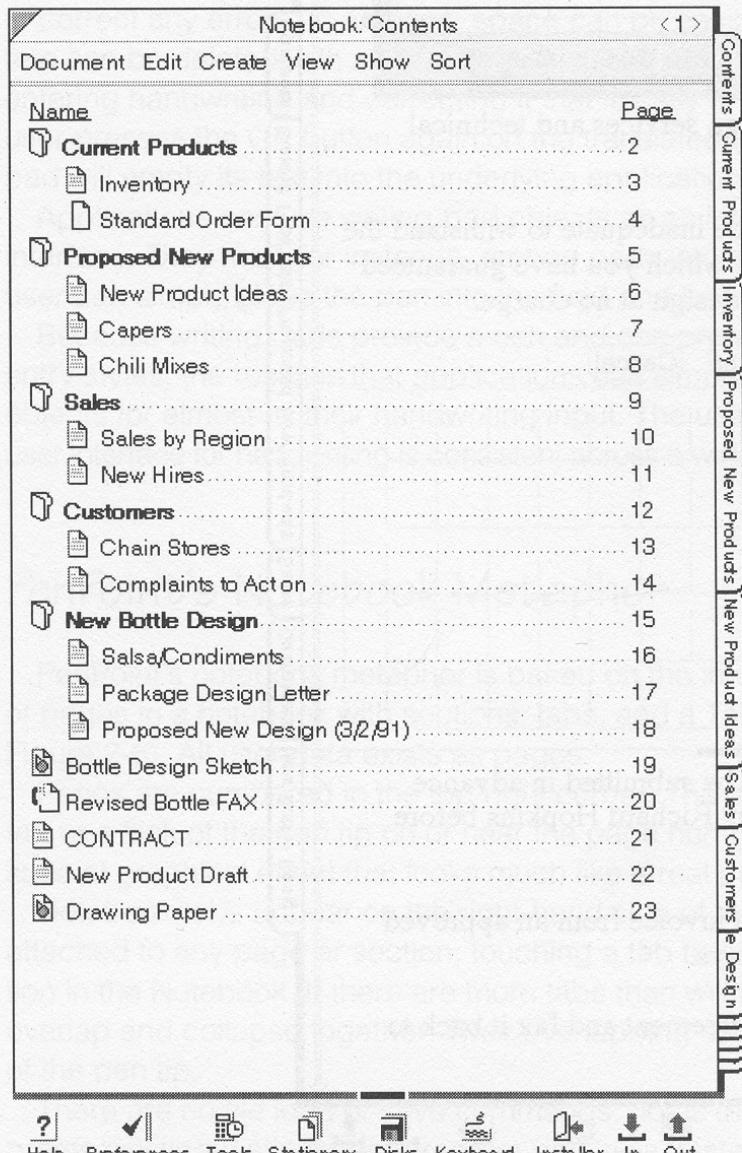
- Technology paradigm
 - To use the device (or program) you need to understand the mechanism
- Metaphor paradigm
 - Let users apply what they know from some familiar part of life in understanding the interface
- Idiomatic Paradigm
 - Design simple interactions and imbue them with meaning



Icons for Familiar Office Objects



Notebook Metaphor – Penpoint, 1991





Good evening.

Click on the door to
sign in...




EXIT



WindowsBeta., to start a program just click on it.

To see the programs in this room, hold down the F1 key.

 Other options

EXIT

@BOB.COM

New Mail

Outgoing

Setting up your e-mail address...

The first step is to subscribe to the Bob E-Mail service.



How to subscribe to the service

The second step is to tell me your account info and e-mail address so I can pick up and deliver your e-mail.



Tell me your e-mail information

Finally, if you have trouble sending or receiving e-mail messages, I can help you fix any problems.



Troubleshoot e-mail problems

Cancel



EXIT



Lava Lamp

Note: This is a decorative object.
It does not start any programs or
do anything special.

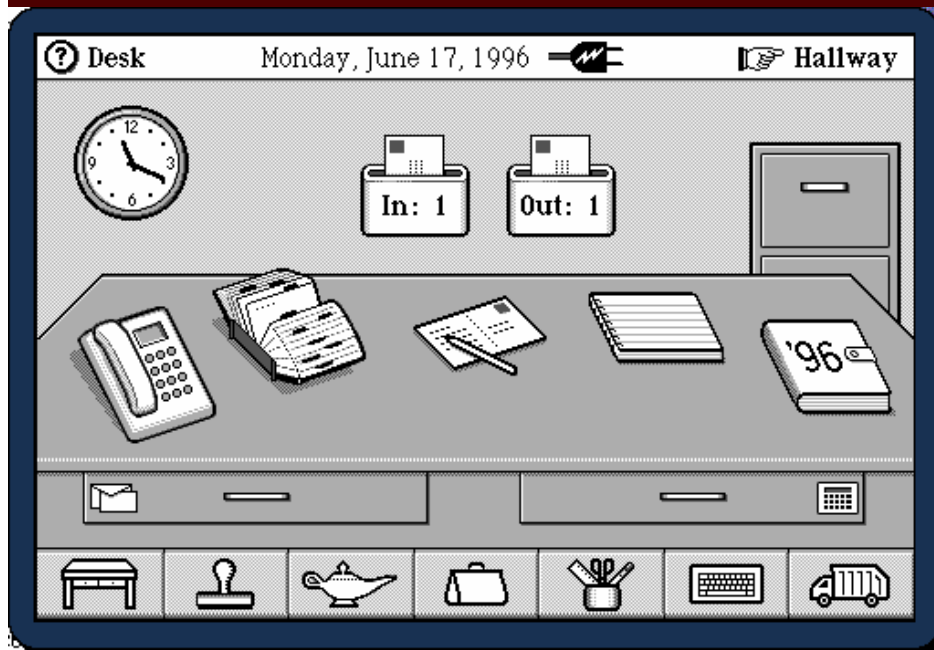
☐ Change it

Cancel



EXIT

House for a PDA – Magic Cap 1994



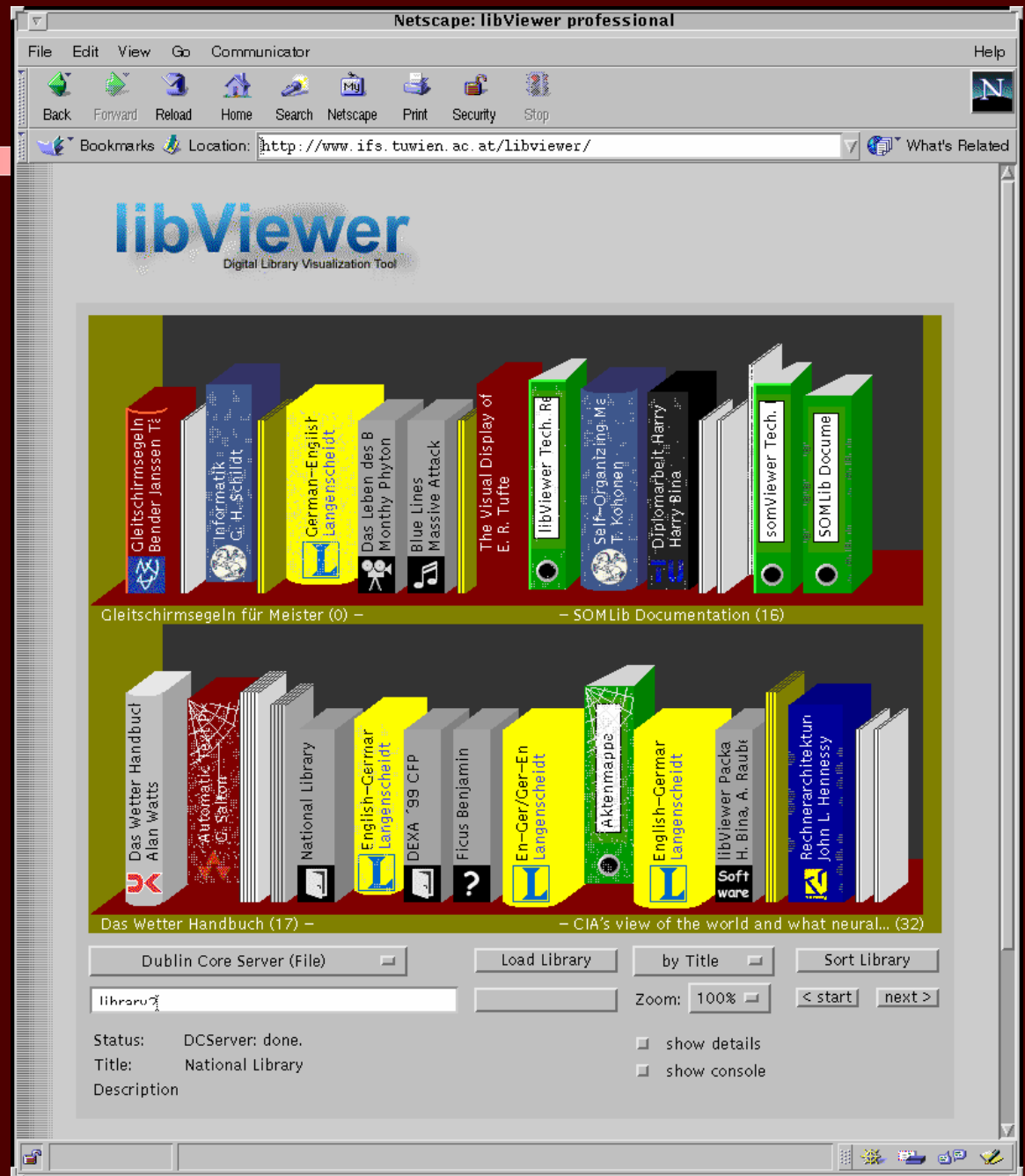
Virtual World metaphor



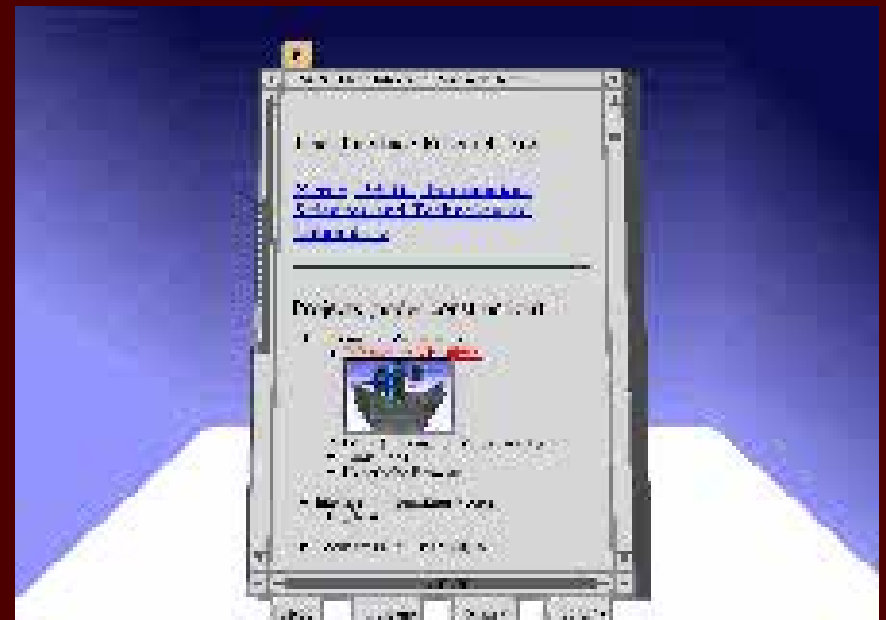
There.com
Secondlife.com



Bookshelf Metaphor



Web Book – Xerox PARC



Physical Device Metaphors



Apple Quicktime 4.0

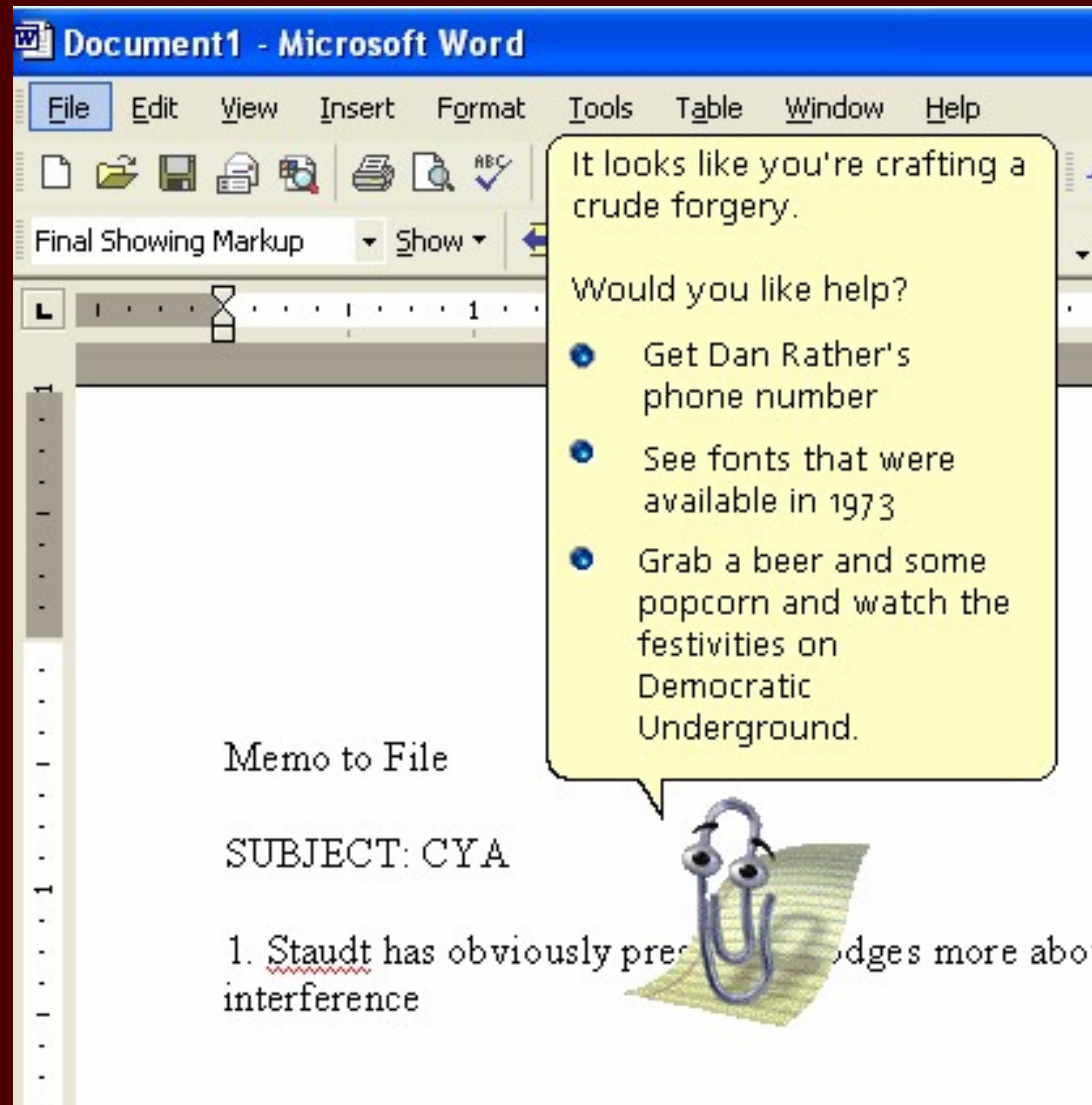


Figure 2-3: IBM's RealPhone Application Interface

Conversational Agents



Clippy - Microsoft



Three basic physical interaction metaphors

- Manipulation:
 - Desktop, notebook,...
- Navigation:
 - WWW, virtual spaces...
- Conversation:
 - Speech, agents...

Transporting metaphor vs. Familiarizing metaphor [Heckel and Clanton]

- Provide a structure that can be learned and that enables new kinds of applications

The Spreadsheet – Visicalc, 1979

HOME BUDGET, 1979			
MONTH	NOV.	DEC.	TOTAL
SALARY	2500.00	2500.00	30000.00
OTHER			

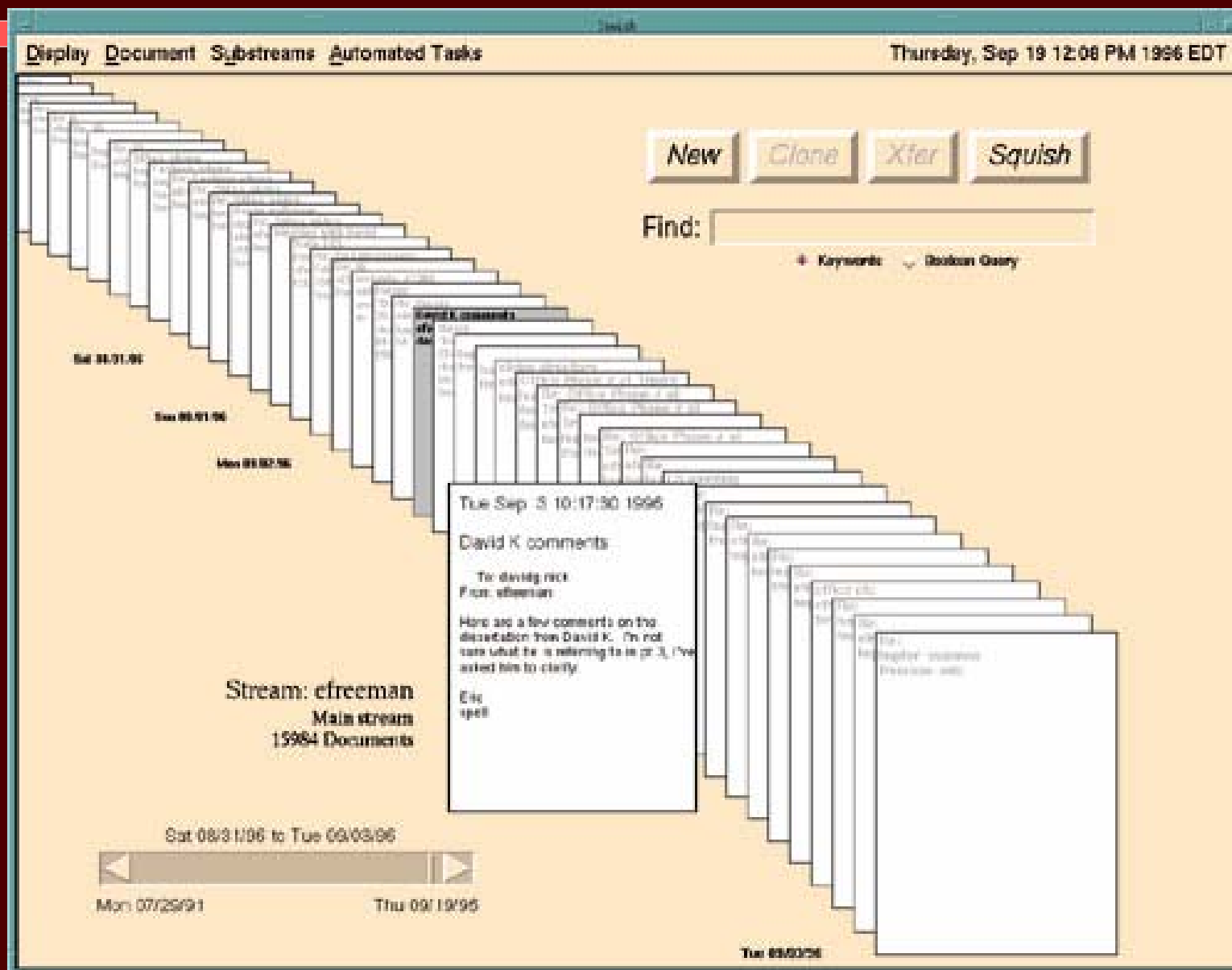
INCOME	2500.00	2500.00	30000.00

FOOD	400.00	400.00	4800.00
RENT	350.00	350.00	4200.00
HEAT	110.00	120.00	575.00
REC.	100.00	100.00	1200.00
TAXES	1000.00	1000.00	12000.00
ENTERTAIN	100.00	100.00	1200.00
MISC	100.00	100.00	1200.00
CAR	300.00	300.00	3600.00

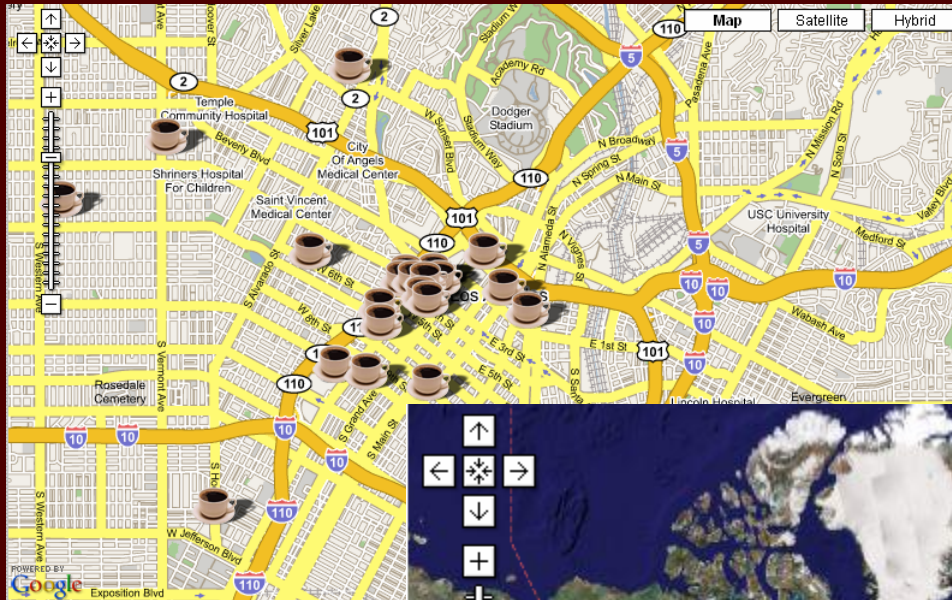
EXPENSES	2460.00	2470.00	28775.00

REMAINDER	40.00	30.00	1225.00
SAVINGS	30.00	30.00	360.00

Timeline Metaphor - Lifestreams, 1997



Map Metaphor(s)



Map Metaphor(s)



[HOME](#) [SEARCH](#) [BROWSE](#) [NEWS](#) [LOGIN](#) [REGISTER](#)

BEGIN HERE

To map your run, enter in a starting location below. Note that if you select an international city, you will not be able to enter in an Address / Zip. State is required for addresses within the United States.

1404 Vacation Road
San Diego
California
United States

[Upload from GPS Unit](#)

DISTANCE

Calculated Automatically

WORKOUT CALCULATOR
Use the form below to calculate your various workout stats for this run.
[\(Switch to Metric Units\)](#)

Find your **Address** in the "BEGIN HERE" box on the left, then click on the map below to plot your Run...
You can now **Drag & Drop** and **Edit** your points. To **Edit**, click on the icon you plotted.
To **Drag & Drop**, click on the icon and while holding your mouse button down you move the icon around the screen!

The map shows a yellow running route plotted along the San Diego coastline. The route starts at the top left, goes south along the coast, then turns inland through San Diego, following a path that includes Pacific Beach, Farnum School, Pacific Beach Dr, Farnum School, Crown Point Elementary Sch, Crown Point Dr, Mission Bay, and ends near Belmont Park. The map also shows various parks, schools, and streets.

Icon Types
☐ Point
☐ Start
☐ Aid
☐ Water
☐ Bath
☐ Stop

Collaborative Tagging

All time most popular tags

amsterdam animal animals april architecture art australia baby barcelona
beach berlin bird birthday black blackandwhite blue boston bridge building bw
california cameraphone camping canada car cat cats chicago
china christmas church city clouds color colorado concert day dc dog dogs england
europe family festival fireworks florida flower flowers food france
friends fun garden geotagged germany girl graduation graffiti green hawaii
holiday home honeymoon house india ireland italy japan july june kids lake
landscape light london losangeles macro march may me mexico moblog
mountains museum music nature new newyork newyorkcity newzealand night
nyc ocean orange oregon paris park party people phone photo pink portrait
red reflection river roadtrip rock rome sanfrancisco school scotland sea seattle sign
sky snow spain spring street summer sun sunset taiwan texas thailand
tokyo toronto travel tree trees trip uk unfound urban usa vacation
vancouver washington water wedding white winter yellow zoo

Three design aspects [Liddle]

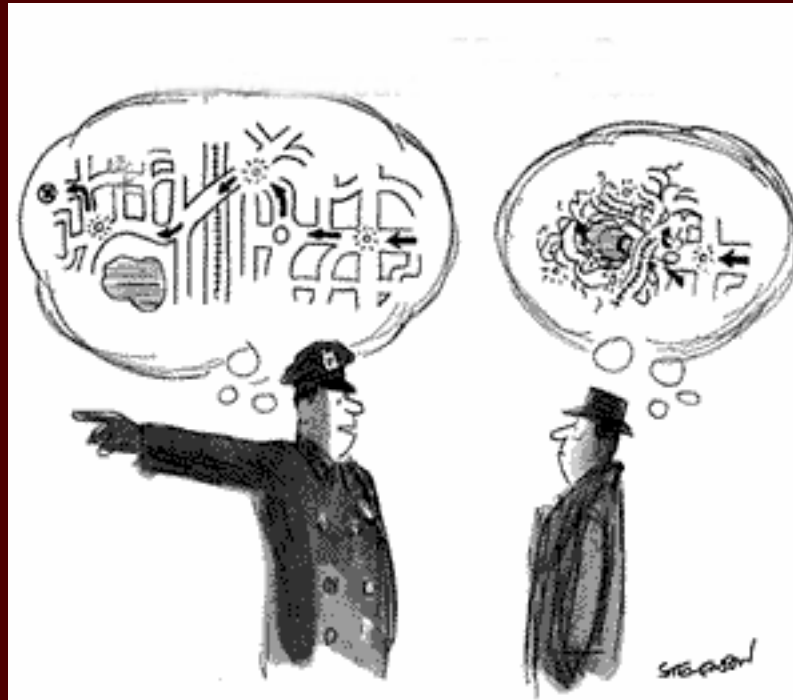
- Conceptual model
- Information display
- Control mechanism

Conceptual Model

- User's concept of (software) system she interacts with
 - Components, properties, interactions
- Goal in interaction design
 - Clear, comprehensible model

Three models of the same system

- Designer's model
- User's model
- System image



How do conceptual models present themselves to the user of a system?

- Implied by the interface metaphor
- Design of affordances
 - (e.g., how much lights up when you do a selection)
- Responses to actions
- Use of natural language terms
 - (e.g., "page, kill, trash") which have prior understandings.
 - In documentation, help, tutorials, etc.
 - In menus, dialog boxes, etc.

Example: Word processing

- Uses metaphors from many worlds
 - language, direct manipulation, typewriter, teletype, typography&printing
- Many conceptual model differences between alternative applications

Example: Formatting a Paper

- What kinds of page elements are manipulable as distinct objects?
- What aspects of their layout can you control?
- What happens when you make changes?
- What is the overall conceptual model for how things are laid out onto pages?
- For that matter, what is a "page"

The Target Layout

Barehands: Implement-Free Interaction with a Wall-Mounted Display

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ABSTRACT

We describe Barehands, a *projection-based* interaction technique, in which the user can control the interaction of various commands and tools on a touch screen by touching it with distant hand gestures. Using behind-screen infrared (IR) illuminators and a video camera with an IR filter, we enable a back-projected SMARTBoard (a commercially available 61" x 47" touch-screen display) to identify and respond to several distant hand gestures. Barehands provides a natural, quick, implementation-independent method of interacting with large, wall-mounted interactive surfaces.

Keywords

interactive techniques, user interface, hand gesture, infrared, image processing, region growing, SMARTBoard, interactive Workspaces, touch interaction, interactive wall

INTRODUCTION

As part of our project to develop a pervasive computing environment [6] we have created an interactive workspace which supports a variety of devices, including laptops, PCs, and large displays, both seated (wall-mounted) and handheld (laptop). Our research focus is on providing suggestions about the system and user interaction levels, so that information and interfaces can be associated with a user and with tasks done with particular devices or surfaces.

Barehands addresses the issue of effective interaction with large touch-sensitive surfaces by employing hand-gesture recognition techniques.

The Overview

A top design criterion for our environment is to provide support for a variety of devices for

existing modes of interaction with applications and standard GUI interfaces (e.g., Windows, **MacOS**). We cannot expect real applications to be developed if they require special re-coding for use in our environment. At the same time, we want to support additional interactions that are more natural to users. These include:

- *display suggestions* (such as providing the equivalent of a typed command for a non-keyboard touch screen)
- *application access* (such as bringing up a web page or application on a screen other than the screen which the interaction occurs, or using a pointing device as a laptop or mouse because on a wall-screen)
- *workspace access* (such as moving up the desktop display)

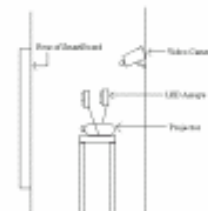


Figure 1: Projection, camera, and lighting setup, side view. The infrared LED arrays are guided in coordination with the camera shutter to illuminate the rear of the board, including objects that might light by being near to it from side. The camera records this image for analysis.

Microsoft Word



Page and column margins

Section with 1 column

Section with 2 columns

Section with 2 columns

Some paragraphs

HTML

Barehands: Implement-Free Interaction with a Wall-Mounted Display

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ABSTRACT

We describe Barehands, a free-handed interaction technique, in which the user can control the invocation of system commands and tools on a touch screen by touching it with distinct hand postures. Using behind-screen infrared (IR) illumination and a video camera with an IR filter, we enable a back-projected SMARTBoard (a commercially available, 61" x 47" touch-sensing display) to identify and respond to several distinct hand postures. Barehands provides a natural, quick, implement-free method of interacting with large, wall-mounted interactive surfaces.

Keywords

Interaction technique, user interface, hand posture, infrared, image processing, region growing, SMARTBoard, Interactive Workspaces, touch interaction, interaction tool

INTRODUCTION

As part of our project to develop a pervasive computing environment [8], we have created an interactive workspace which integrates a variety of devices, including laptops, PDAs, and large displays, both vertical (wall-mounted) and horizontal (desktop). Our research focus is on providing integration at both the system and user-interaction levels, so that information and interfaces can be associated with a user and task rather than with a particular device or surface.

Barehands addresses the issue of effective interaction with large touch-sensitive surfaces by employing hand-posture recognition techniques.

The Overview

A key design criterion for our environment is to provide support on a variety of devices for

existing modes of interaction with applications and standard GUI interfaces (e.g., Windows, PalmOS). We cannot expect real applications to be developed if they require special re-coding for use in our environment. At the same time, we want to support additional interactions that are not in current systems. These include:

- + device augmentation (such as providing the equivalent of keyboard shortcuts for a non-keyboard touch screen)
- + multi-device actions (such as bringing up a web page or application on a screen other than the one on which the interaction occurs, or using a pointing device on a laptop to control the cursor on a wall-screen)
- + meta-screen actions (such as working up the desktop display)

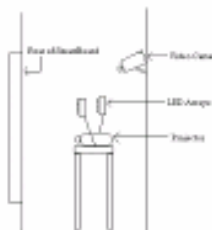


FIGURE 1: Projection, camera, and lighting setup, side view. The figured LED arrays are pulsed in coordination with the camera shutter to illuminate the rear of the board, including objects that reflect light by being near to its front side. The camera records the image for analysis.

Table 1 row, 2 col

Table 1 row, 2 col

Table 3 row, 2 col

Some paragraphs

HTML Source

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<html><head>  <title>Untitled Document</title></head>
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  Implement-Free Interaction with a Wall-Mounted
  Display</font></b></center>
<p></p><p>
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  <tbody>
    <tr>
      <td width="51%">
        <p></p>
        <center><b>Meredith Ringel</b><br>
        Computer Science Department<br>
        Brown University<br>
        Providence, RI 02912<br>
        mringel@cs.brown.edu<br>
        </center>
      </td>
      <td width="49%">
        <p></p>
        <center><b>Henry Berg, Yuhui Jin, Terry Winograd</b><br>
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        {hgberg, yhj, winograd}@cs.stanford.edu<br>
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  We describe Barehands,...interactive surfaces.</font></p>
        <p align="Justify"><b><font size="-1"
face="Arial">Keywords</font></b><font size="-1"><br>
  Interaction technique, ... interaction tool.</font></p>
        <p align="Justify"><b><font size="-1"
face="Arial">INTRODUCTION</font></b><font size="-1"><br>
  As part of our project ...surface.</font></p>
        <p align="Justify"><font size="-1">Barehands ...
  techniques.</font></p>
```

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  for our environment
  is to provide support on a variety of devices
  for</font></p>
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  These include:<br>
    </font>
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            augmentation ...screen)</font></p>
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        <tr valign="Top">
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          <td width="91%">
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            wall-screen)</font></p>
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        </tr>
        <tr valign="Top">
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            ...display)</font></p>
          </td>
        </tr>
      </tbody>
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  </td>
</table>
<p></p>
<center><font size="-1">
</font></center>

  <p align="Justify"><i><font size="-1"><br>
  FIGURE 1: Projection, ... analysis.</font></i></p>
  </td>
</tr>
</tbody>
</table>
</p></body></html>
```


Powerpoint

Text boxes
(everything with
grey borders
and handles)

Barehands:
Implement-Free Interaction with a Wall-Mounted Display

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We describe Barehands, a free-handed interaction technique, in which the user can control the movement of system components and work on a touch screen by touching it with distance-based gestures. Using behind-the-screen infrared (IR) illumination and a video camera with an IR filter, we enable a back-projected SMARTboard (a commercially available 61 3/4" x 47" touch-screen display) to identify and respond to several distance-based gestures. Barehands provides a natural, quick, implementation-agnostic method of interacting with large, wall-mounted interactive surfaces.

Keywords: Interactive technique, user interface, hand gesture, infrared, image processing, region growing, SMARTboard, interactive Workspaces, touch interaction, interaction tool.

INTRODUCTION
As part of our project to develop a pervasive computing environment [6] we have created an interactive workspace which integrates a variety of devices, including laptops, PDAs, and large displays, both vertical (wall-mounted) and horizontal (tabletop). Our research focus is on providing interactions across the system and user-interactive levels, so that information and interfaces can be connected with users and with each other with appropriate devices or surfaces.

Barehands addresses the issue of effective interaction with large touch-sensitive surfaces by employing hand-gesture recognition techniques.

The Question
A key design question for our environment is to provide support for a variety of devices for

existing modes of interaction with applications and standard GUI interfaces (e.g., Windows, PalmOS). We cannot expect real applications to be developed if they require special re-coding for use in our environment. At the same time, we want to support additional interactive data access techniques not possible with the current paradigm of separate interfaces for desktop and touch-screen.

- multi-device access (such as bringing up a web page on applications on a screen while also interacting with the interactive screen, e.g. using a handheld device to highlight a point because it is a wall-screen)
- cross-screen access (such as bringing up the working display)

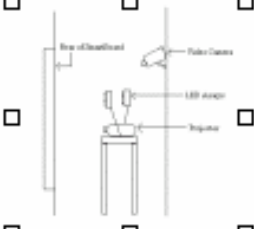


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Picture

The Concept of “Paragraph”

- Non-computer: Semantic unit
 - One thought, start on new indented line with topic sentence
- Word: “the” building block of a document
 - Carries formatting, even used for figures, headers
- HTML: One building block of a document
 - Forces whitespace -> often misused for layout
- PowerPoint: not part of natural model
(visuals+bulleted lists), added later from Word

The Concept of “Layout”

- Non-computer: Typographical-physical
 - Cut & Paste anywhere
- Word: Mostly typographical
 - Sections [with attributes like #columns], paragraphs [with attributes like indent.], inconsistent pictures model (added late), tables
- HTML: Sequential, but gone bad
 - Intended for simple sequential “scroll” rendering
 - But: tables used to create page layouts
 - “Don’t let HTML become the DOS of the WWW!” [Alan Kay, WWW3, 1995]
- PowerPoint: Graphical
 - Overlapping objects, no flow beyond page

Back to Metaphor

- A metaphor implies many elements of the model to a user who is familiar with the metaphorical object (e.g., a physical desktop)
- In general a model requires more learning without metaphors to which users can anchor it to their previous experience.
- There is a fine line between metaphor and non-metaphor (e.g., in natural language "The stock market is up today").

Problems with metaphors

- Don't scale well
- Too constraining
- Conflict with design principles
- Makes true functionality invisible
- Overly literal translations
- Can limit the designer's imagination

The Myth of Metaphor [Cooper]

- ... basing a user interface design on a metaphor is not only unhelpful but can often be quite harmful. The idea that good user interface design is based on metaphors is one of the most insidious of the many myths that permeate the software community.
- Use 'em if you find 'em, but don't bend your interface to fit some arbitrary metaphoric standard. *[Cooper]*