Command Selection & User Expertise

Gilles Bailly
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Human-Computer Interaction
Iron Man
iForm [Leithinger 2013]
We present «LazyNav» a tool to evaluate interaction techniques for ground navigation in 3D scenes.

LazyNav [Guy 2015]
ISkin [Weigel et al. 2015]
1. "HCI is just designing cool devices"
HCI

Improve artefacts

Understand phenomena

Creating Tools
1. "HCI is more than designing cool devices"
2. "Desktop workstation is dead"
SketchPad  [Sutherland 1963]
"The world is changing…

…we should design beyond the desktop"
"Microsoft’s Kinect: The New Mouse?" 

"The mouse dies"

[CIO for the city of Palo Alto]

"Touch is king"

"The mouse is ancient […], the mouse is outhere"

[Al Farsoldt]
Desktop workstation is a timeless interactive system.

High level of comfort during extended computing sessions.
"A device is well suited for some tasks, and not for others"

[Buxton]
The game playing fields in ICSC stadiums are always 100 meters long, and 75 meters wide. The teams are used to many stadium ranges, always using the same strategy: first, they make all passes along the length of the field, and then they do the same along the width of the field.

<table>
<thead>
<tr>
<th>Mowing along the length of the field</th>
<th>Mowing along the width of the field</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100,75</td>
</tr>
<tr>
<td></td>
<td>100,75</td>
</tr>
</tbody>
</table>

All passes are straight lines, parallel to the sides of the field.
Today (and probably tomorrow)

Millions of users are spending several hours per day working on their old good workstation.
PC games > 2x console games
The desktop is **NOT** dead!
3. "The GUI model (or WIMP) is dead"
Command line Interface

- Codified
- Strict

Graphical User Interface

- Metaphor
- Exploratory

Natural User Interface

- Direct
- Intuitive

[wikipedia]
[root@localhost ~]# ping -q fa.wikipedia.org
PING text.pmtpa.wikimedia.org (208.80.152.2) 56(84) bytes of data.
^C
--- text.pmtpa.wikimedia.org ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 540.528/540.528/540.528/0.000 ms
[root@localhost ~]# pwd
/root
[root@localhost ~]# cd /var
[root@localhost var]# ls -la
total 72
drwxr-xr-x. 18 root root 4096 Jul 30 22:43 .
drwxr-xr-x. 23 root root 4096 Sep 14 20:42 ..
drwxr-xr-x. 2 root root 4096 May 14 20:15 account
drwxr-xr-x. 11 root root 4096 Jul 31 22:26 cache
drwxr-xr-x. 3 root root 4096 May 18 16:03 db
drwxr-xr-x. 3 root root 4096 May 18 16:03 empty
drwxr-xr-x. 2 root root 4096 May 18 16:03 games
drwxrwxr-x. 2 root gdm 4096 Jun 2 18:39 gdm
drwxr-xr-x. 38 root root 4096 May 18 16:03 lib
drwxr-xr-x. 2 root root 4096 May 18 16:03 local
dlwxrwxrwx. 1 root root 11 May 14 20:12 lock -> ../run/lock
dlwxrwxrwx. 1 root root 10 Jul 30 22:43 log
ndlwxrwxrwx. 1 root root 10 Jul 30 22:43 mail -> spool/mail
ndlwxrwxrwx. 2 root root 4096 May 18 16:03 nis
dlwxrwxrwx. 2 root root 4096 May 18 16:03 opt
dlwxrwxrwx. 2 root root 4096 May 18 16:03 preserve
dlwxrwxrwx. 2 root root 4096 Jul 1 22:11 report
ndlwxrwxrwx. 1 root root 6 May 14 20:12 run -> ../run
ndlwxrwxrwx. 14 root root 4096 May 18 16:03 spool
dlwxrwxrwt. 4 root root 4096 Sep 12 23:50 tmp
ndlwxr-xr-x. 2 root root 4096 May 18 16:03 yp
[root@localhost var]# yum search wiki
Loaded plugins: langpacks, presto, refresh-packagekit, remove-with-leaves
rpmfusion-free-updates | 2.7 kB 00:00
rpmfusion-free-updates.rep | 206 kB 00:04
rpmfusion-free-updates.sha | 2.7 kB 00:00
updates/metallink
updates | 5.9 kB 00:00
updates/primary_db
73% [====================================] 62 kB/s 2.6 MB 00:15 ETA

Command Line Interface
Command line Interface

Graphical User Interface

Natural User Interface

CLI
- Codified
- Strict

GUI
- Metaphor
- Exploratory

NUI
- Direct
- Intuitive
GUI = WIMP

Windows

Icon

Menu

Pointer

WIMP [merzouga 1980]
Command line Interface

Graphical User Interface

Natural User Interface

- Codified
- Strict

- Metaphor
- Exploratory

- Direct
- Intuitive
Is it a WIMP Interface?
Windows
Icon
Menu
Pointer
Windows
Icon
Menu
Pointer
Windows
Icon
Menu
Pointer
Windows
Icon
Menu
Pointer
GUI (WIMP) is NOT dead
Part 1  HCI & Popular Thinking
• HCI is more than just designing cool devices
• The desktop workstation is not dead
• The GUI (WIMP) model is not dead

Part 2  Future of Desktop & GUI
International Collegiate Business Competition (ICBC) is famous for its well-kept rectangular stadium. The grass playing fields in ICBC stadiums are always 100 meters long, and 75 meters wide. The spare lawn mower always uses the same strategy: first, it mows all rows of lawns along the length of the field, and then it moves to the width of the field.

Mowing along the length of the field

Mowing along the width of the field

100,75
Users perceive computer in visual details
Computers perceive users as a cursor+keys
Multi-screen setup
Why do we manually arrange monitors?
WideBand [Mackinlay 2004]
WideBand  [Mackinlay 2004]
multi-touch

Thumb buttons

weights
This mouse is connected to an air pump by an air hose.
more output modalities?
Visual: Optimus maximus
Haptic: Métamorphé [Bailly et al. 13]
Text entry
Keyboard shortcuts

Ctrl
Keyboard shortcuts
Games
MagicDesk [Bi et al. 2011]
MagicDesk [Bi et al. 2011]
Curve [Wimmer et al. 2010]
Chair Gestures [Probst 2014]
the left over 113° Axis: yaw

under review
LivingDesktop [Bailly et al. 2016]
LivingDesktop [Bailly et al. 2016]
LivingDesktop [Bailly et al. 2016]
LivingDesktop [Bailly et al. 2016]
LivingDesktop [Bailly et al. 2016]
be connected

capture more user inputs

provide more feedback

be integrated in the environment
Desktop

GUI
Leveraging user expertise
Data to manipulate (and to visualize)

continuously increase

=> more commands
GUI = WIMP

Windows
Icon
Menu
Pointer

Easy to criticize, difficult to improve
keyboard shortcuts
Menu

Hotkey
Ctrl+C - Ctrl+V

Speed
24 April 2013
Trent Proc
Title
Company Name
4321 First Street
Anytown, State ZIP

Dear Trent,

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

keyboard shortcuts

gesture shortcuts
Patina [Matejka 2013]
shortcuts are very efficient…

… but are seldom used
# Mouse Gestures

## Navigation

<table>
<thead>
<tr>
<th>Gesture</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>History Forward</td>
<td>Close</td>
</tr>
<tr>
<td>History Backward</td>
<td>Up a Directory</td>
</tr>
<tr>
<td>Reload</td>
<td>Scroll Up (200px)</td>
</tr>
<tr>
<td>Forced Reload</td>
<td>Scroll Down (200px)</td>
</tr>
<tr>
<td>Homepage</td>
<td>Tabbed Browsing</td>
</tr>
<tr>
<td>New Document</td>
<td>Duplicate Tab</td>
</tr>
<tr>
<td>Duplicate Window</td>
<td>Next Tab</td>
</tr>
<tr>
<td>Minimize Window</td>
<td>Previous Tab</td>
</tr>
<tr>
<td>Maximize/Restore</td>
<td>New Tab</td>
</tr>
</tbody>
</table>

## Image Functions

<table>
<thead>
<tr>
<th>Gesture</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Close</td>
</tr>
<tr>
<td></td>
<td>Double Size</td>
</tr>
<tr>
<td></td>
<td>Half Size</td>
</tr>
<tr>
<td></td>
<td>Hide Image</td>
</tr>
</tbody>
</table>

## Miscellaneous

<table>
<thead>
<tr>
<th>Gesture</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Start over image</td>
</tr>
<tr>
<td></td>
<td>View Source</td>
</tr>
<tr>
<td></td>
<td>View Cookies</td>
</tr>
<tr>
<td></td>
<td>View &lt;META&gt; Info</td>
</tr>
<tr>
<td></td>
<td>Add Bookmark</td>
</tr>
</tbody>
</table>

## Links Functions

<table>
<thead>
<tr>
<th>Gesture</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Link in new window</td>
</tr>
<tr>
<td></td>
<td>Link in new tab</td>
</tr>
<tr>
<td></td>
<td>Horizontal Stack</td>
</tr>
<tr>
<td></td>
<td>Open every link dragged over (window)</td>
</tr>
<tr>
<td></td>
<td>Open every link dragged over (tab)</td>
</tr>
</tbody>
</table>
"Yes, some gestures are natural. But how many? I would say a handful."
shortcuts are very efficient…

… but are seldom used
Framework of User Expertise [Scarr et al. 11]

Performance

Menu

Performance dip

Shortcut

Practice

decades
How to help users to switch... …from novice to expert behavior?
Idealised performance

Menu

Shortcut

Practice

decades

Performance
"Guidance should be a physical rehearsal of the way an expert would issue the command"

Gordon Kurtenbach

Marking menus [Kurtenbach et al. 91]
Marking Menus

Linear Menus

time: 0.00 secs.

Hammer
<table>
<thead>
<tr>
<th>Marking Menus</th>
<th>Linear Menus</th>
</tr>
</thead>
<tbody>
<tr>
<td>time: 0.00 secs.</td>
<td>time: 1.58 secs. Hammer</td>
</tr>
</tbody>
</table>
... and about *keyboard shortcuts*?  

ExposeHotKey
ExposeHotkey [Malacria et al. 2013]
Bonjour,

Vous trouverez ci-dessous le programme de la formation "analyse de données avec le logiciel R"

Analyse de données

Public : chercheurs, ingénieurs, étudiants, professionnels

Prérequis : connaître les bases de l'analyse statistique (analyses univariées)

1ère session : 27 avril 2016
2ème session : 25 mai 2016
3ème session : 15 juin 2016
4ème session : 23 juillet 2016

Olivier Colot
Fwd: [crisal-permanents] [ri-reslab] TR: Program...
SkillOMeter [Malacria et al. 2013]
Graphical User Interface

Leveraging user expertise
Part 1  
HCI & Popular Thinking
- HCI is more than just designing cool devices
- The desktop workstation is not dead
- The GUI (WIMP) model is not dead

Part 2  
Future of Desktop & GUI
- Leveraging context-awareness of Desktop
- Leveraging users’ expertise in GUI

Part 3  
Understand users’ behaviors

Outline
Understand users’ behaviors

Collecting data

Synthesize phenomena into models
Collecting data: Applications

Number of commands per application?

Which command shortcuts mapping?

Consistency across applications?
Collecting data: Applications

How to analyze these data?

Menu Inspector  [Bailly et al. 2013]
Collecting data: Users

Which gestures? Which fingers?

Work-In-Progress
Manual annotation ....
Sub challenges

Collecting data

*Synthesize* phenomena into models
User studies

Time consuming

Cost
Can we predict...

...the performance of an interface?
Predicting user behavior: a difficult exercise

GUI

Menus
Machine learning
do not explain cognitive process

HCI

Cognitive Science
complex
difficult to apply
Time = f(
&
Gaze distribution
)

menu length
menu organization
target position
practice
Gaze distribution

\[ \text{menu length} \]

\[ \text{menu organization} \]

\[ \text{target position} \]

\[ \text{practice} \]

\[ = f( ) \]

\[ \text{menu length} \]

\[ \text{menu organization} \]

\[ \text{target position} \]

\[ \text{practice} \]
Serial Search
Directed Search (novice)
<table>
<thead>
<tr>
<th>Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Recent</td>
</tr>
<tr>
<td>Save</td>
</tr>
<tr>
<td>Save As</td>
</tr>
<tr>
<td>Save All</td>
</tr>
<tr>
<td>Export</td>
</tr>
<tr>
<td>Configure</td>
</tr>
<tr>
<td>Print</td>
</tr>
<tr>
<td>Close</td>
</tr>
</tbody>
</table>

Directed Search
(intermediate)
<table>
<thead>
<tr>
<th>Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Recent</td>
</tr>
<tr>
<td>Save</td>
</tr>
<tr>
<td>Save As</td>
</tr>
<tr>
<td>Save All</td>
</tr>
<tr>
<td><strong>Export</strong></td>
</tr>
<tr>
<td>Configure</td>
</tr>
<tr>
<td>Print</td>
</tr>
<tr>
<td>Close</td>
</tr>
</tbody>
</table>

Directed Search (Expert)
Open Recent

- Save
- Save As
- Save All
- Export
- Configure

Print

Close

Visual Search
- Serial search
- Directed search

Mouse Control
- The "Single move" strategy
- The “Tracking” strategy
Serial Search + Directed Search + Pointing

[Bailly et al. 2014]
Can we integrate models into design tools?
MenuOptimizer

[Bailly et al. 2013]
Designing menus is easy but…
Designing **usable** menus is **difficult**
MenuOptimizer

Designer

Edit goals and assumptions

Feedback

Optimizer

Edit suggestions
MenuOptimizer [Bailly et al. 2013]
Part 1

**HCI & Popular Thinking**
- HCI is more than just designing *cool* devices
- The desktop workstation is *not* dead
- The GUI (WIMP) model is *not* dead

Part 2

**Future of Desktop & GUI**
- Leveraging *context-awareness* of Desktop
- Leveraging *users’ expertise* in GUI

Part 3

**Understand users’ behaviors**
- Need of *data & models*
Take away messages
1. Desktop workstation is not dead

it will be more context-aware
The Future Desktop

- be connected
- capture more user inputs
- provide more feedback
- be integrated in the environment
2. GUI model is not dead

it will leverage users’ expertise
Patina [Matejka 2013]

Marking menus [Kurtenbach et al. 91]

ExposeHotkey [Malacria et al. 2013]

SkillOMeter [Malacria et al. 2013]

"Guidance should be a physical rehearsal of the way an expert would issue the command."

Gordon Kurtenbach

(a) Novice mode
(b) Expert mode
Immediate usable

Aware of the expert mechanisms

Fluid transition from novice to expert behaviors

The Future GUI
3. We should put efforts on Understanding users’ behaviors
Collecting data: Applications

Challenge:
$10^3$ users $\times 10^2$ applications $\times 10^3$ commands

Menu Inspector  [Bailly et al. 2013]

Manual annotation ....

Menu Inspector  [Bailly et al. CHI’14]

MenuOptimizer  [Bailly et al. 2013]
HCI Research
at Télécom ParisTech & CNRS
1. Future Desktop will be more context-aware

2. Future GUI will leverage users’ expertise

3. We should put efforts on understanding users’ behaviors