# **Graphical interaction**

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### **Direct manipulation**

- 1. Continuous representation of the objects of interest
- 2. Physical actions instead of complex syntax
- 3. Rapid, incremental, reversible actions whose effects on the objects of interest are immediately visible
- 4. Layered approach to discover the interface progressively, so that it can be used with little previous knowledge







#### Direct manipulation + menus + forms

#### BEWARE of the notion of object of interest

Objects of the application domain Characters, words, paragraphs of a text Pixels of an image, graphical shapes, ... Menus and forms are NOT objects of interest

Direct manipulation vs. Indirect Manipulation

Direct manipulation of the *objects of interest* ≠ Interaction with *menus and forms* 

## 3 levels of graphical interaction

#### **Basic actions**

"alphabet" of graphical interaction

#### **Basic interaction tasks**

"vocabulary" of graphical interaction

#### **Interaction patterns**

"syntax" of graphical interaction

6







## **Basic actions**

Interaction through a mouse or trackpad and a **cursor Pointing** : move cursor to designate an object **Activation** : click (simple / multiple / with modifier) **Drag** : move cursor with button pressed **Keyboard input** : keys and/or modifiers

## Feedback of basic actions



#### Activation



## Extend activation actions



Conventions:

Right click = contextual menu Simple click = select ; Double clic = open Shift-clic = add/remove from selection

### Feedback of basic actions



ghosts







## **Basic actions**

Interaction through a mouse or trackpad and a cursor **Pointing** : move cursor to designate an object **Activation** : click (simple / multiple / with modifier) **Drag** : move cursor with button pressed **Keyboard input** : keys and/or modifiers

Interaction through a touch screen (finger or pen) **Tap** : one or more contact points without movement **Swipe** : short motion of one or more contact points **Pinch** : motion of 2 fingers in opposite directions

### **Basic interaction tasks**

Input tasks

Selection tasks

Trigger tasks

Navigation tasks

Property setting tasks

Transformation tasks

### Input task : numbers



Note : the scale needs not be linear



### Input task : text

Single-line text field

Text cursor

Validate with Return or Tab key

Default value

Name of field

Name:

Multi-line text area

Name

text spanning multiple lines



### Input task : shapes

Position



Bounding rectangle

**Control points** 

Free form



### Input task

Adapt interaction to the type of value : size of a table



## Selection task

Select one or more items in a set Size of the set : small, medium, large Content of the set : fixed or variable Selection : one or more items

Fixed content, small/medium size Single selection: Radio buttons, Combo box



### Selection task

Select one or more items in a set Size of the set : small, medium, large Content of the set : fixed or variable Selection : one or more items

Variable content, medium/large size Simple selection : List, Hierarchical list, Icons





## Selection task

Select one or more items in a set Size of the set : small, medium, large Content of the set : fixed or variable Selection : one or more items

Variable content, medium/large size Multiple selection : by group, by interval, by add/remove





## Trigger task

#### **Buttons**



Links

Add comment

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#### Drag-and-drop

Move an object to a drop zone The action depends on both the source and destination





## Trigger tasks: Menus and palettes

Menu bar + pull-down menu



Tool palette



Pop-up menu

Hierarchical menus

Pull-off menus







## Trigger task: Radial menu

Pie Menus (Hopkins)





Selection three times as fast as a linear menu but limited to 8 items

Marking menus (Kurtenbach)



Transition to expert mode : the menu is not displayed when the selection gesture is executed quickly

#### Marking Menus

#### Linear Menus



#### time: 1.19 secs.

Hammer

#### time: 1.58 secs. Hammer

#### Marking Menus - Kurtenbach & Buxton, 1993

## Trigger task: gestural input





Octopus - Bau & Mackay, 2008

#### Access content that is not visible

#### Scrollbars

The thumb represents the position of the view in the document Scrolling direction is the opposite of direction of motion of the thumb Division of attention between scrollbar and content





Amount of information

Access content that is not visible

**Direct scrolling** 

Direct manipulation of the content

Automatic scrolling when reaching the side of the view



Access content that is not visible

**Direct scrolling** 

Direct manipulation of the content

Automatic scrolling when reaching the side of the view



Access content that is not visible

Pan-and-Zoom Zoom in to see detail Pan to scroll Zoom out to see context





Push the wheel to zoom in or to zoom out?

Access content that is not visible

Hypertext links or navigation buttons Navigate to other part of the content (table of content, references, ...) Navigate to next/previous page Navigate to other content



#### Property and parameter specification task

Dialog boxes Fields + OK / Apply / Cancel buttons Modal or non-modal



Temporal and spatial decoupling between the specification of the command, its parameters, and its execution

**Optional parts** 







Problem with OK button

### Transformation tasks

#### Manipulation handles



### Transformation tasks

#### Manipulation handles



### Interaction patterns

Combinations of basic interaction tasks

Complex data input

Selection

Dialog box

Inspector

Tool palette

## Complex data input

#### Text with format

Phone number Credit card number Date

#### +33 1 69 15 69 10 accept spurious characters



#### Form





| Nov 2020 🔹 🔍 |    |    |    |    |    |    |
|--------------|----|----|----|----|----|----|
| Мо           | Tu | We | Τh | Fr | Sa | Su |
| 26           |    |    | 29 |    |    | 1  |
| 2            | 3  | 4  | 5  | 6  | 7  |    |
| 9            | 10 | 11 | 12 | 13 | 14 | 15 |
| 16           | 17 | 18 | 19 | 20 | 21 | 22 |
| 23           | 24 | 25 | 26 | 27 | 28 | 29 |
| 30           | 1  | 2  | 3  | 4  | 5  | 6  |

## Syntax of graphical interaction

A command requires :

one (or more) object(s) of interest [the subject] an action [the verb] parameters (sometimes)

2 possibilities :

Specify first the object(s) of interest *then* the action Subject-verb syntax Better when applying several actions to the same objet Specify first the action *then* the object(s) of interest Verb-subject syntax Better when applying the same action to several objets

### Subject-verb syntax: the selection

The selection is the object (or set objects) that the command will be applied to

It is specified by direct designation of the objects, which are highlighted

The selection is specified by direct designation



The action is specified with menus, buttons, drag-and-drop Invalid actions should be deactivated (greyed-out)

## Subject-verb syntax: the selection

#### **Command parameters**



Problems :

Requires to close the dialog box before seeing the effect

=> "Apply" button

Large number of parameters

=> optional part

=> tabs







Effects of changes or immediately visible

Work area Selection of the objects of interest Property inspector of selected objects



Patterns d'interaction

#### Syntaxe sujet + verbe : la sélection

On appelle "sélection" le ou les objets au(x)quel(s) va s'appliquer la prochaine action

La sélection est spécifiée par désignation directe des objets d'intérêt et mise en évidence visuellement

La sélection est spécifiée par désignation directe





L'action est spécifiée par menus, boutons, drag-and-drop Les actions invalides peuvent être désactivées (grisées)



### Property boxes – the Xerox Star (1981)

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| Units                                      | Inches                | 7             |                  |                  |                |         |       |         |            |
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| Hyphenation                                | Use Hyphe             | enatio        | n                |                  |                |         |       |         |            |
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| Margins                                    | Left                  | 0             |                  |                  |                |         |       |         |            |
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Select tool in palette



Set tool parameters



Apply tool to object of interest





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| Width  | n: 32 px • Opacity: 75 % • Flow: 100 % • Hardness: 80  | % ▼ More Ø Stabilizer Ŷ G Length: 35 ▼ Symmetry |
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| <ul> <li></li> <li></li></ul>      | Displays for Office Automation<br>Large, High-Resolution, Bit-Map<br>• many uses at same time<br>• text and graphics<br>• display like printed paper   |   |
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#### Modes

Mode = state of the interface where user actions are interpreted consistently, and differently than in other modes

Problems: Mode visibility, mode change

Examples

"vi" text editor :

Type "Esc" to switch between input/command modes "emacs" text editor :

User Control and Meta modifiers to enter commands Tool palettes:

Select a tool to activate it



#### Modes

**Temporal modes** 

The same user action performed at different <u>times</u> has different effects Problem : Initiative of the mode change

Spatial modes

The same user action performed at different locations has different effects

Quasi-modes

Temporal modes activated as long as a physical action is sustained

An interface is a collection of modes

### Conclusion

3 levels of analysis of graphical interaction

Basic actions:

Pointing, Activation, Dragging

Basic interaction tasks:

Input, Selection, Trigger, Navigation,

Property/parameter specification, Transformation

Interaction patterns:

Complex data entry, Subject-Verb vs Verb-Subject, Selection, Dialog boxes, Inspector, Tool palette

### Conclusion

Direct manipulation + Indirect manipulation Menus & Forms

Modes organize/structure the interface Spatial vs. temporal

Analyzing interfaces in terms of basic interaction tasks Input (new information) vs select (among existing info.) Generic methods vs. specific ones

Exercise: analyze (multi-)touch interfaces