

INDUSTRIAL DESIGN CENTER
IITB, MUMBAI

POET&HCI

*PSYCHOLOGY OF EVERYDAY THINGS
AND HUMAN COMPUTER INTERFACE*

SPECIAL PROJECT BY

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APPROVAL SHEET

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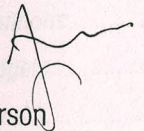
Psychology of Everyday things and Human Computer Interface

By

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Is approved towards partial fulfillment of degree of
Master In Industrial Design.

Guide



Chairperson

Examiner

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Psychology of everyday things (POET)

Everyday things, being inanimate objects are not expected to have a psychology, a term normally associated with animate or living things. But Donald Norman's book "The Design of Everyday Things" is based on the very idea of everyday things having a psychology. His idea came from the fact that people have definite notions of how things work and how they go wrong. Donald Norman describes influencing factors in usability of everyday things as the result of the interaction involved in working on everyday things.

Acknowledgements

This project was immensely helped by the learning experiences of my friends with computer soft wares.

I'd like to thank all my friends and the faculty of IDC for their encouragement and help and to my guide Prof. Joshi for his valuable inputs and assistance.

How everyday things work

It can be said of any device, equipment or a gadget at a time, place, a calling as, or as service as a device that there are some basic parameters that can define the "interface layer".

The basic assumptions about the working of everyday things can be listed as:

- Everyday things offer to do something, in some way and under certain conditions
- All have an understanding of how everyday things work
- Everyday things can be made to work in a desired way
- All can and expect to working of everyday things to make them work right

Donald Norman defines the following as the elements of Psychology of Everyday Things (POET)

Affordances

The perceiver and actual properties of the thing that determine how the thing can be used are called affordances

Psychology of everyday things (POET)

Everyday things, being inanimate objects are not expected to have a psychology, a term normally associated with animate or living things. But Donald Norman's book 'The Design of Everyday things' is based on this very idea of everyday things having a psychology, this idea came from the fact that people have definite notions of how things work and how they go wrong. Donald Norman describes the influencing factors in usability of everyday things as the psychology arising out of the interaction involved in working on everyday things.

This interaction can be said to happen in an "interface layer" between the user and the thing. And it is in this interface layer, the attributes and dimensions influencing usability comes into play. Similar can be said about the computers, as the interface in the form of monitor is the major tool for interaction and getting the work done.

The computer interface is not a static interface as any other everyday thing or device may have. The computer interface is a dynamic one due to the range of tasks involved. So in order to understand the influencing factors in interface design, a clear understanding of influencing factors in everyday things' design will help.

How everyday things work

It can be said of any device, equipment or a gadget as complicated as cameras or as simple as a bottle cap that there are some basic parameters that can define the 'interface layer'.

The basic presumptions about the working of everyday things can be listed as.

- Everyday things offer to do something, in some way and under certain conditions
- All have an understanding of how everyday things work
- Everyday things can be made to work in a desired way
- All can act or react to working of everyday things to make them work right

Donald Norman defines the following as the elements of Psychology of Everyday things (POET):

Affordances

The perceived and actual properties of the thing that determine how the thing can be used are called affordances.

Mapping

Relationship between two things is called mapping. It may be in the form of spatial analogy, pattern similarity, action analogies or volumetric analogies. Mapping works with objective dimensions.

Constraints

Constraints limit what can be done. Affordances suggest the range of possibilities; constraints limit the number of alternatives. Constraints put to prevent things from going wrong are termed as forcing functions. These serve to avoid mistakes, slips and errors. Forcing functions may be of preventive or confirmatory nature.

Mental model

The mental model is the idea of things and how they happen. Mental models are formed because of natural tendency of humans to find explanation for everything. Mental models are influenced by affordances, mappings and constraints involved. This is also referred to as Conceptual model or user model. This stands for the set of concepts about a thing, users must understand in order to be able to work on it.

Computers Interfaces and POET

Computer Interfaces offer to do a variety of tasks on one platform, with a set of elements. Graphic user Interface (GUI) offers a work area consisting of windows, icons, menus and pointers (WIMP) as elements. These elements are used across a variety of applications having a 'goal' or 'the task that a user may wish to accomplish'. In dealing with these programs or applications the user employs his understanding of these elements. These elements like any other everyday thing has some psychology associated to them. Therefore psychology of these elements influences the user interaction, learning, and ease of use, error free operation and speed of use.

There can be following levels of Human computer Interface at which the POET can be applied

Hardware: The most basic 'idea of computer'.

Operating System (OS): The platform that is common to all types of applications.

Applications (GUI): The programs through which a user accomplish certain types of tasks with the help of some tools like image editors, word processor

Interaction: The activities that are proactively done by the user to get the desired work accomplished through the computer.

Widgets: The elements on which the actions by the user are performed.

Icon: Icon is the graphic or a symbol that gives a clue of a process, action or activity that may result after clicking it.

Interaction, widgets and icons are interdependent categories as Interaction makes use of widgets and icons and all the three are used in applications and Operating systems.

There are various examples of POET across the various hardware levels and across various operating systems. Following discussion touches some aspects of POET across these levels but the project emphasis is on identifying the elements of POET and their implications across the applications.

The idea of computer and OS

The computer, when explained to the new users, is almost always described as comprising of three units- the CPU, input devices (keyboard and mouse) and output devices (monitor, printer)

This description serves as a mental model, because it gives an overall understanding of computers in general as a concept.

This Conceptual model of computer can further be seen as being built upon different conceptual models of Keyboard, monitor, peripherals and CPU.

Looking at the keyboard, there are clearly defined zones as the function keys, alphanumeric keys, direction/navigation keys and numeric pad. Here we see mapping based on functions or what a key afford to do.

This is still the hardware level of understanding. When a user uses the computer, the first thing that is encountered is the Operating system

If we consider the conceptual model behind an operating system we can see many parallels between real world and computer concepts, a mapping intended to make understanding easier.

Terms like Files, Folders, Window, Panes, Recycle bin, Trashcan are a direct analogy from real world objects.

Actions like cut, copy, and paste are represented by their real world analogies of scissors, twin sheets (copies) and a pasteboard. The 'save' is still characterized by a floppy, a practice continuing from days when people used save their 'working' data on removable devices due to small hard disks.

Also, once an analogy is established, it's continued through different levels. Like files are the 'things' you work upon, folders are the places where you store them. To open a file on computer, icon represents the opening of a real-world-file-like thing, despite the fact that 'opening' as an action could also have been mapped to opening a bottle by an opener, a door handle opening a door, opening eyes etc.

Similarly 'new' comes to be represented by a blank sheet.

A magnifying glass, binoculars or eyes invariably represent 'Search' and 'Find'.

The 'windows explorer' earlier known as file manager represents the files and folders in a 'tree-structure'.

There too for sake of mapping, Desktop is placed on the topmost level, because the user encounters the desktop first. If we go by the actual location, desktop is a folder located in windows directory.



Also, sheets of paper going from one folder to another show the copying and move processes.

All icons afford to be clicked, with left click being mapped as 'open' or 'activate' whilst right click being mapped as 'context' or 'properties'.

Similarly links afford only clicking. Icons for folders and files afford drag and drop too.

Some icons like recycle bin and folders also afford to be 'dragged over'. That means one can drag and drop any folder or file over recycle bin or any other folder.

F1 key is mapped as 'Help' in almost all applications, whilst F3 key is mapped as Search (not in word 2000).

In windows explorer there are few hidden maps, carried over from DOS model. For instance, if some folder or drive is selected and * on numeric pad is pressed, the folder or drive is expanded.

Sometimes a combination of keys is mapped to a specific task, such a universal mapping can be found as Ctrl+C, Ctrl+V and Ctrl+S. In windows the flag (⌘) key is mapped to do many functions in combination with other letters, e.g. ⌘+R=run, ⌘+E= explorer, ⌘+F=find, ⌘+M= minimize.

The "confirm delete" dialog box is an example of forcing function.

The applications running on a platform (OS) also share a range of mappings amongst themselves. Also there are several mental models and forcing functions in an application depending on the nature of task it performs.

OS and Applications

Operating system uses *Desktop metaphor*-the interface with windows, icons, menus and pointers.

An icon, in form of a graphic or a button has default affordance to be clicked upon. The icon being clicked (action) depends on the 'intention' towards the 'goal'.

Sometimes this tendency to click is so overwhelming that the user may find it impossible to work in absence of a pointing device such as a mouse. This being an exceptional case when mouse is not working and can be rare, but it brings out an interesting illustration of mapping.

Now suppose mouse is not working, what is the next available navigational aid? -The arrow keys. But arrow keys only move the selection (blue highlight); so "enter" must be pressed to execute the command. Similarly, flag key

combinations (⌘+R=run, ⌘+E= explorer, ⌘+F=find, ⌘+M=minimize, ⌘+A=desktop icon starting with A is highlighted) can be used to launch applications. Once windows explorer is opened, TAB key can be used to navigate through the two panes and address bar. To go up or down in a pane, up-down arrow keys are used.

Now once an application is opened, Alt+F, E, V, W, H etc can bring file, edit, view, window, help etc menus.

Likewise in Internet Explorer, Ctrl+O opens a URL, Ctrl+N opens a new window. To go back to the previous page 'backspace' is pressed. To go forward 'shift+backspace' is pressed. 'Ctrl+Tab' navigates across frames and address bars, 'Tab' navigates across different links within a frame.

Now if a keyboard does not have a flag key? –Pressing Ctrl+ESC will bring about the 'start' menu, after that it's an arrow up-down-right-left business.

Thus, it can be seen that a combination of keys like 'shift', 'tab', 'ctrl', 'alt' and arrows can be used to perform a range of tasks. Add to this the functionality of function keys and we have hundreds of mappings.

But not all people use these hot keys.

Reason can be attributed to the degree of familiarity. The new users need more clues as affordances and feedback to their actions. As the familiarity with the application environment increases, users feel more confident and look for 'fast-action-keys' as feedback is not that important now as speed is. Here the use of hot keys is preferred. Such types of users are often termed as power users. They tend to use more of "knowledge in the head" than 'knowledge in the world' which here, is the interface,

Thus we see that effective use of mapping greatly increases the effectiveness of computers. But at the same time, the onus of providing feedback shifts to other areas of Interface, as the 'action' by the user still is on the interface or the 'world'. So to ensure the action to be in right direction, the user must be able to perceive and interpret the state of world. These can be achieved using the principles of POET.

Applications

Applications are defined as those computer programs that offer to accomplish a certain type of result as per the expectation of the user. They may be word processors, image editors, layout applications, cad package etc.

This project focuses on applications for identification of examples of POET because applications do some *definite, comparable and isolatable tasks*.

Definite: The task having clear goal and Intention.

Comparable: The tasks being done by one package is comparable to similar package by some other company. This offers the samples to be compared against similar examples in a 'it not this, then what' type of scenario.

Isolatable: the examples under consideration should be fairly isolatable in the sense that their intention, implication and outcome can be judged without elaborate dependencies.

The applications consist of a vast set of components. These can be classified as

Actions

The actions are the steps proactively done by the user, on the interface using some input device. In applications, the actions are

Clicking

Scrolling

Dragging

Mouse over or hover

Focusing (by TAB or hover)

Command (series of input from keyboard)

Or a combination of above(click+drag, command+click etc)

Intentions

Intentions are the results anticipated as a result of these activities. Intentions are

Select

Navigate

Decide (choose among) options, actions

this is different from the *selection* in the sense that this is more of an elimination of other 'choices' or alternatives in the *intent*, leading to selection of one action. This may be as simple as a yes/no decision or complex as selection out of many choices.

Alter/change/modify (manipulative functions)

Stretch/shrink, rotate, skew, flip, move, delete

Apply (result generative functions)

setting the attributes or properties e.g. fill, outline, brush, filters, grammar, spelling, fonts and styles

Preserve and Retrieve (result retention and re-application functions)

save, preserve style sheets, macros, layouts, protection, appearance, customized toolbars etc.

Organize structuring of data, workflow etc.

Widgets

The things, on which the actions are being performed, in order achieve the goal or intent of the user, are called widgets. These are the very basic component of any interface

E.g.

Selection is done by *clicking, hovering, or both, drag and include, drag and cross, tab to focus* on the **icons, buttons**

Navigation is done by *scrolling, zooming, panning* by **scroll bars, zoom tool**

Decision is done by choosing an option from *menus, set of check boxes, set of radio buttons, list boxes, combo boxes, value sets, floating value sets*, etc.

Manipulative functions are achieved by manipulating *cursor shapes, bounding boxes, tools, buttons, sliders, icons, etc.*

Icons

The icons represent a function or an action. They are usually the 'click and act' process. These are integral part of an application interface.

These elements of application interface together makes a 'world' with which the user interacts and gets the work done. They represent a collective knowledge to be used and put into action by the user.

To illustrate the principles of POET, examples from application like Microsoft Word 2000, Excel 200, Adobe Photoshop 6, Illustrator 9, Corel 10, and Freehand 9 are taken.

Affordances

Affordances in a status bar

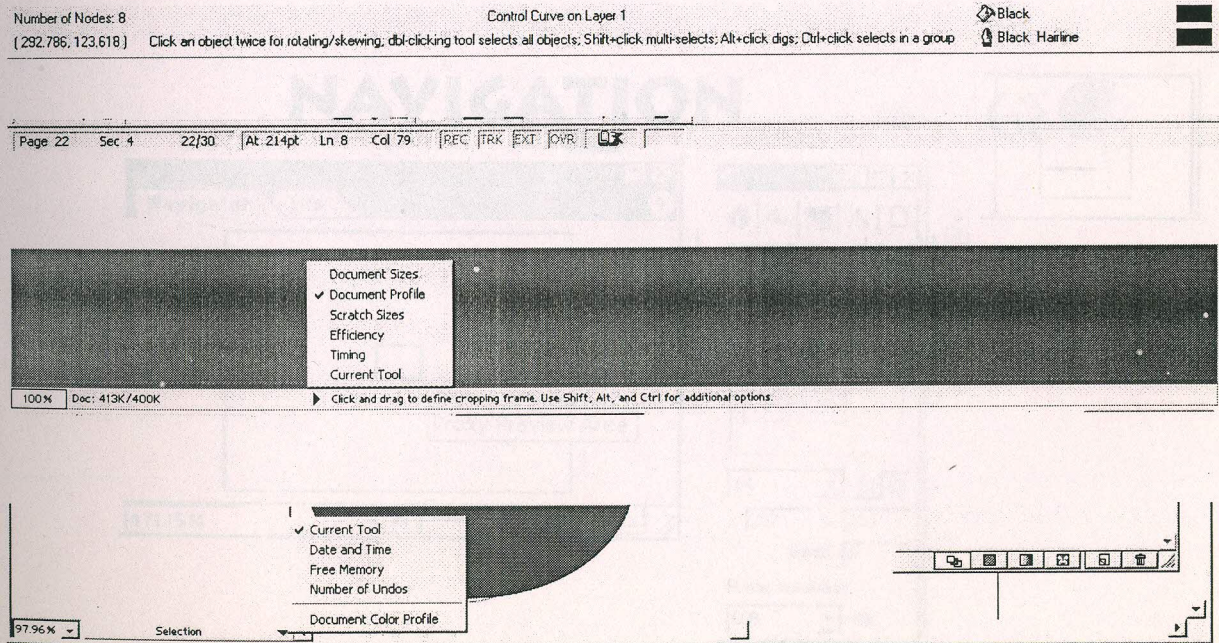
A status bar appears normally at the bottom of the screen and serves primarily to give information about the action being performed, the cursor position, page number etc. Affordance to click is provided in status bar by using different the elements:

Use of icons or graphic

Dimmed text in a box represent 'some mode that can be activated'

Presence of arrows gives a clue of expanding menus

Presence of list boxes showing choice by expansion

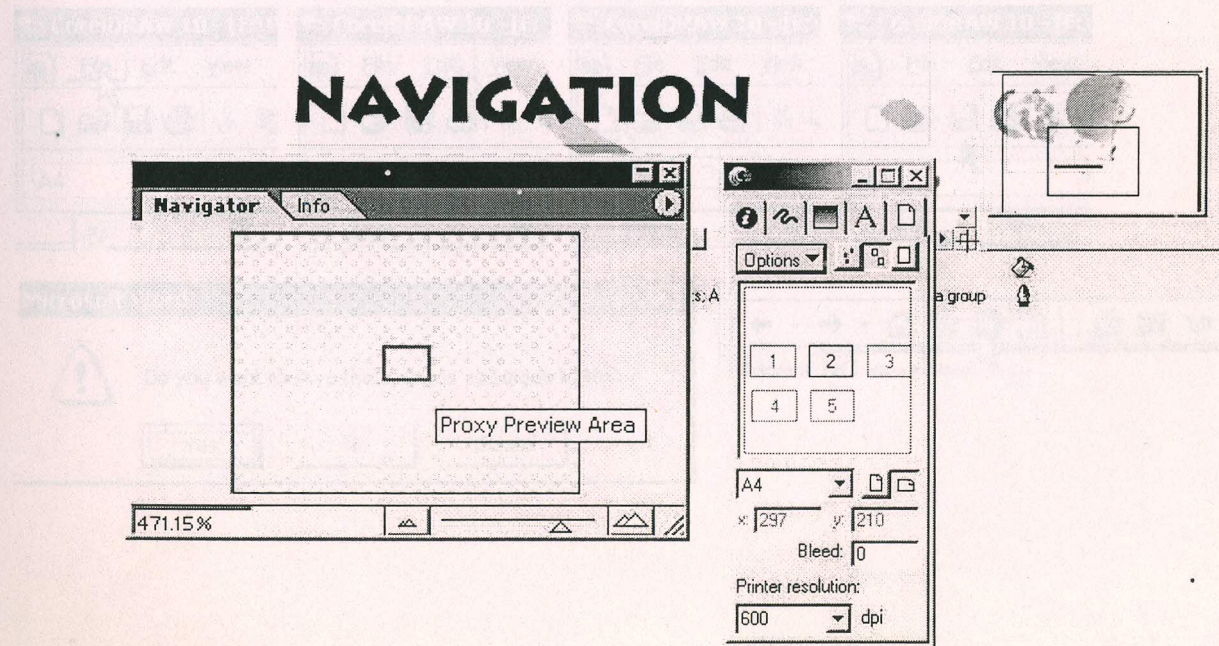


Affordances in Navigation

Navigation is done by zooming and panning across work area that may or may not span multiple pages and across multiple pages. There are controls for either zooming or panning. In Adobe applications, zooming is done by a fixed slider and panning is done by dragging that is afforded by change of cursor when it's taken over the red box.

Corel applications has navigation based on panning only, zoom level being what is set in document. Hitting N will bring up the navigation window with the cursor shape as the box, panning is done by moving the cursor, clicking will exit the navigation window. Clicking the area at the intersection of scroll bars also brings up the navigation window.

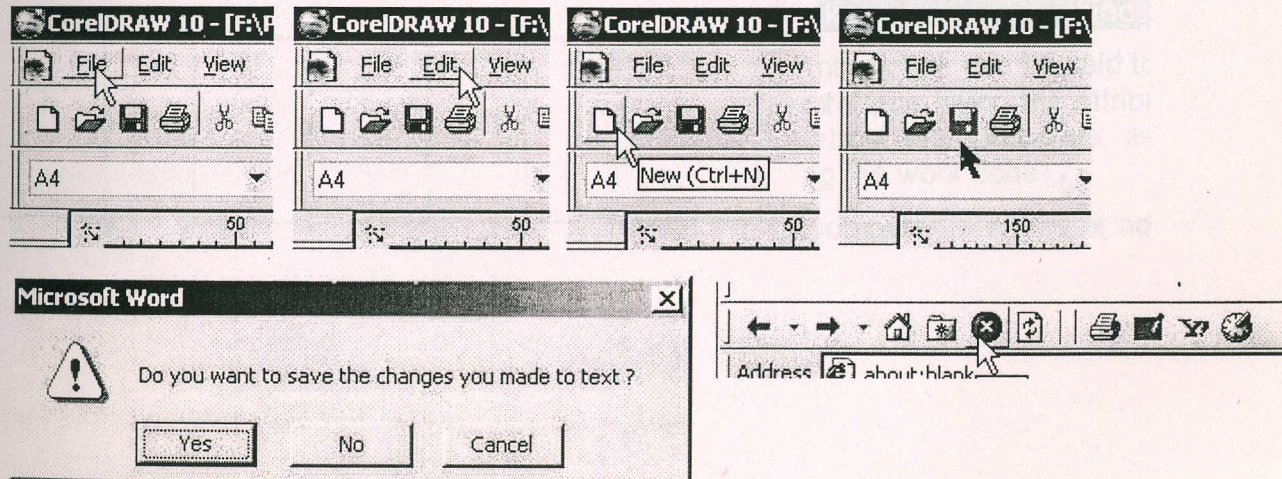
Free hand navigation box affords to navigate between pages. There is no clue as to how to pan the view, active page is shown in black and rest are shown gray outline and there are icons for setting the page preferences and preset zoom levels.



Affordances for Clicking

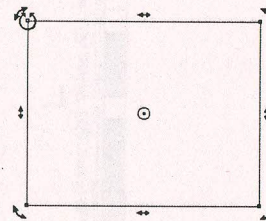
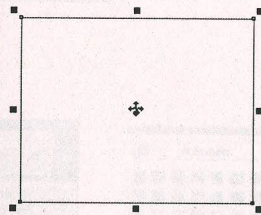
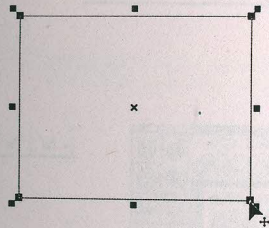
Clicking is afforded for icons and buttons through following clues:

1. 3d shadow of icon/button when cursor moves over the button or icon
2. As soon as cursor is moved over, the icon/button changes colors.
3. A surrounding box appears on the button/icon that is 'active' either by mouse over or by tab to field.
4. 'Focus' or highlight of an item on mouse over gives clue about its click-ability.



Affordances as cursor shapes

Cursor shapes depict different modes and thus communicate the way they should be handled to perform a function.



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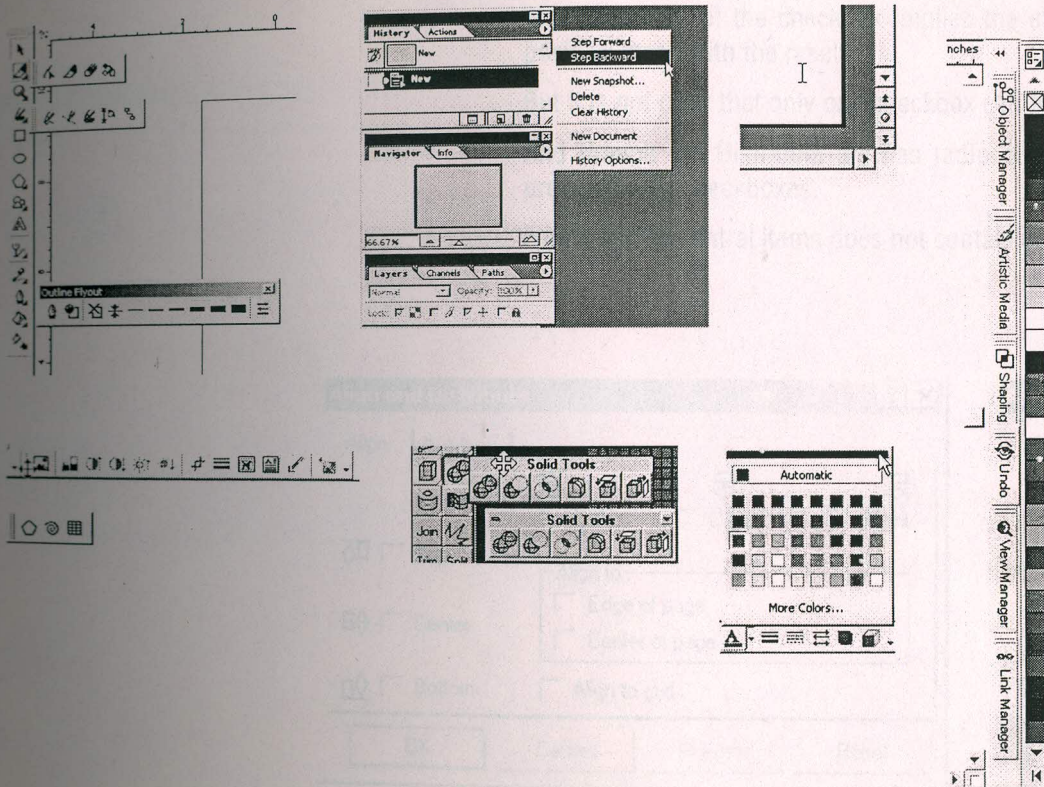
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Mappings Arrows



Affordances in an arrow

- Fly out
- Takes to next level
- Expands
- Scrolls
- Pulls out the fly out
- A pair of arrows is used as the expander, which changes its direction and becomes a collapser when a Docker is expanded.

Different types of bar-heads : the shapes that afford tear-out

Mappings

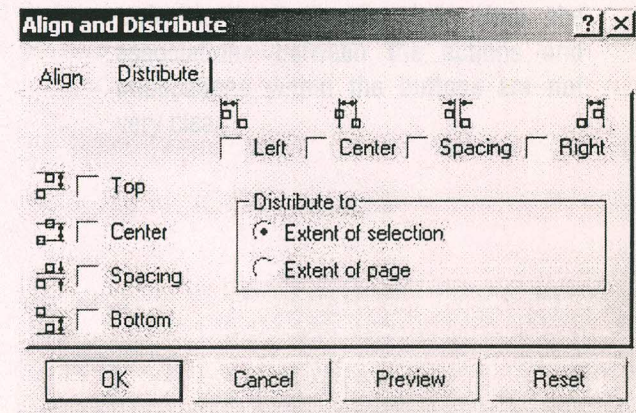
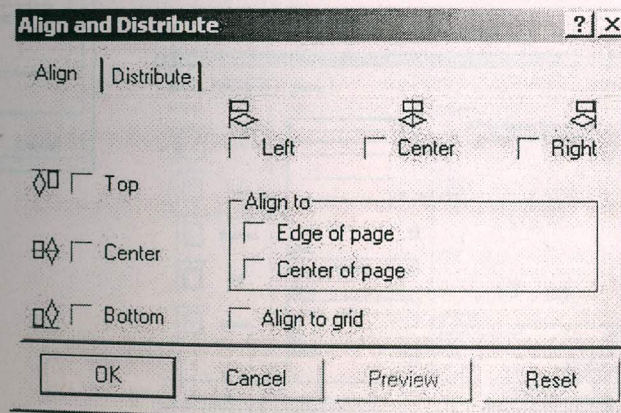
Placements

The placement of the checkbox implies the effect or the result that'll be obtained on checking it. The position maps with the result.

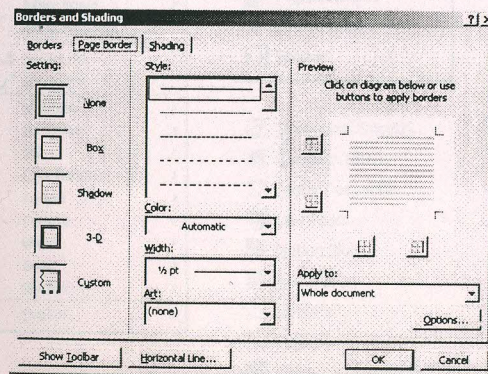
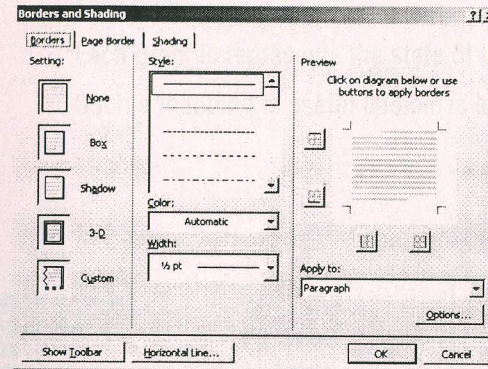
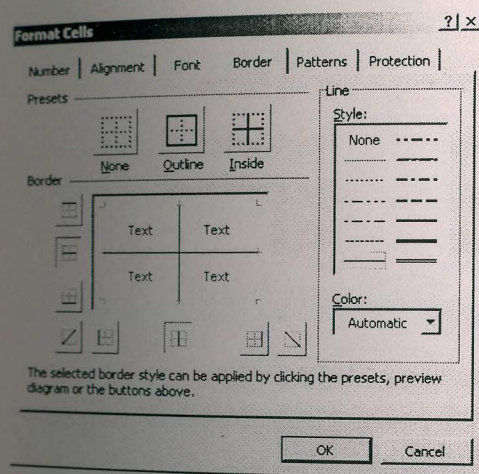
But it is not clear that only one checkbox can be selected in a row or column.

And though the Distribute tab has radio buttons in the central area, similar function in Align Tab is provided with checkboxes.

Frame for the central items does not contain any graphical clue as other items have.



Borders



The Border Box of M\$ excel has clearly placed buttons for top/side/central/inside borders and the buttons for the border styles are placed at the top as another chunk in bigger side. The line-weight settings can be done from the right.

In M\$ Word the buttons for top/side/central/inside borders are on the right, in the center are the line weight settings and the buttons for the border styles are at the far left. Here the associations between the actions and implications within the buttons are not very clear.

Parts visible and implications clear

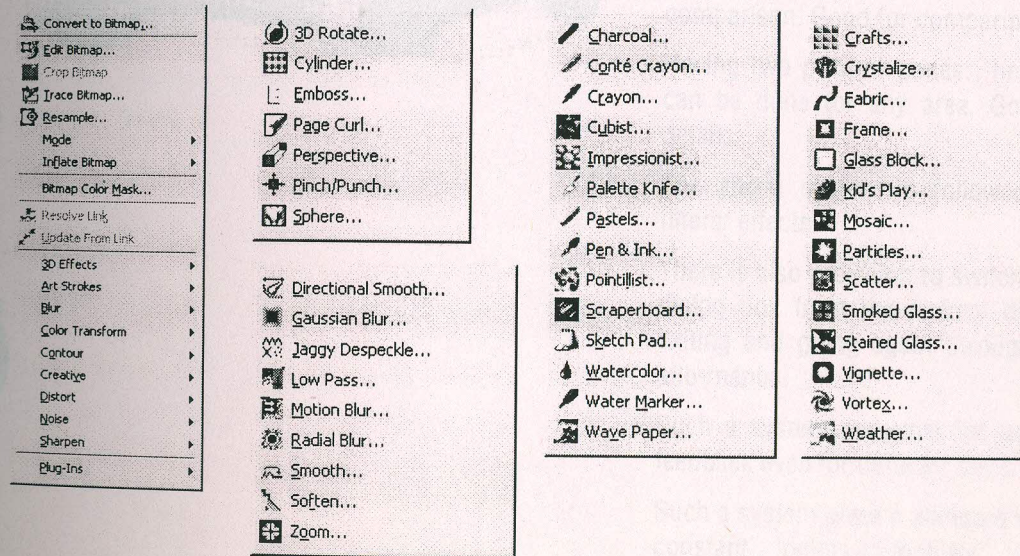
Corel 10

Use of graphics for each filter improves mapping.

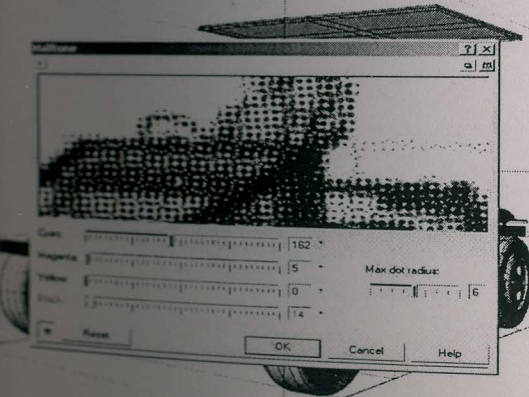
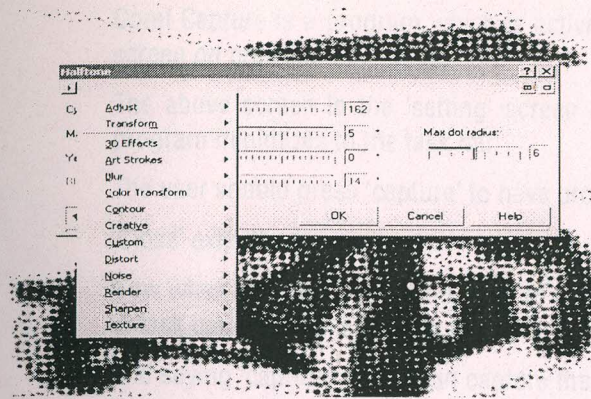
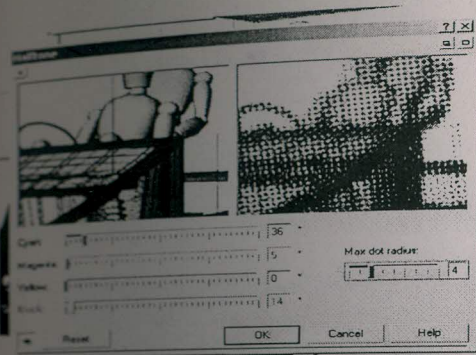
When applying filter, the user may judge the nature of the outcome by the graphic associated with the each filter.

Each graphic represents the state of the world after that filter is applied.

Such a mapping is useful and aides learning for novices and advanced beginners.



Filter Boxes



Corel Photo Paint 10 filter box has three possible states,

Having no preview pane: the changes done are shown in the image/graphic on which the effect is applied. Good for putting numeric values that affect the change.

Having one preview pane: the preview pane shown the change while the background is the original graphic that serves as the control or the comparison. Good for comparing overall effect.

Having two preview panes: here the comparison can be done for any area. Good for comparing details.

The above system is followed through all the filters/ effects.

There is also provision to switch to different effect dialog box from the current dialog box without exiting and going again through the menus and sub-menus.

Such a system accounts for good mapping and feedback even for different sizes of work area.

Such a system gives a standard workflow or some constant 'points-to-look-for' in other words different goals or intentions are mapped through similar steps to improve understanding

Intentions versus Actions

Corel Capture is a program which is active in the background and captures the image on the screen on pressing the hot key.

The above screen in the 'setting' screen on Corel Capture. After the settings are done, the program minimizes to the task bar.

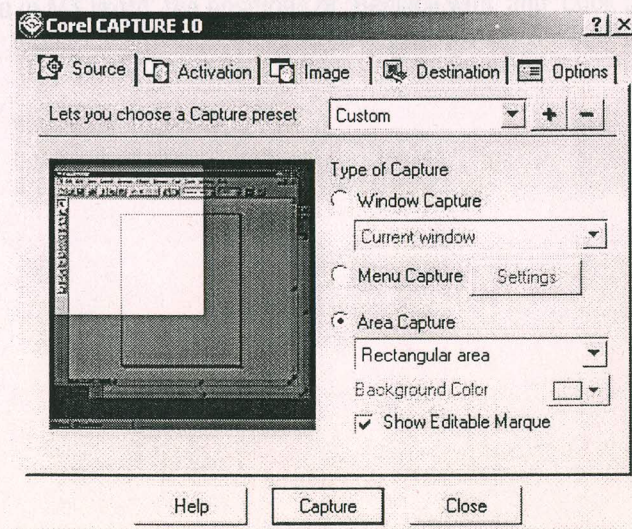
The user should press 'capture' to have program minimized to task bar.

'Close' exits the program.

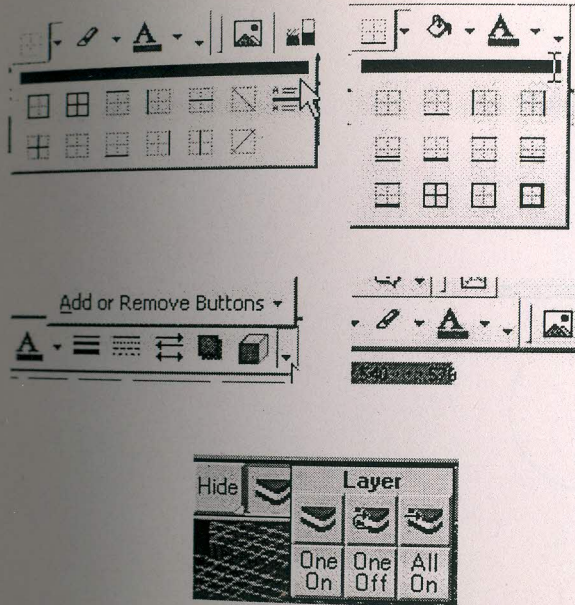
Now when the user has an intention of closing this setting dialog, or to minimize the program to task bar, he should press 'capture'

And saying 'capture' may mean capture the screen right now.

Pressing 'close' exits the program altogether, whereas it seems that it'll close the settings dialog.



Confusions



The way different Border styles are arranged in M\$ Excel and Word toolbars make it very difficult to know what order is mapped.

The arrow expanding to 'Add or remove buttons' appears at the end of all toolbars in M\$ office applications. When this arrow occurs next to an arrow expanding to a menu, confusion is created. When the toolbar is compressed due to smaller screen resolution, a double chevron appears above 'Add or remove buttons' arrow.

In Rhinoceros3D, the fly out for 'Layers' menu have three icons in a row and three buttons having text in the row below it. Though the text buttons have different functions, it seems that they describe the icons.

In the Thesaurus menu in M\$ Word, the positions of 'Replace with' and 'Look Up' are crossed.

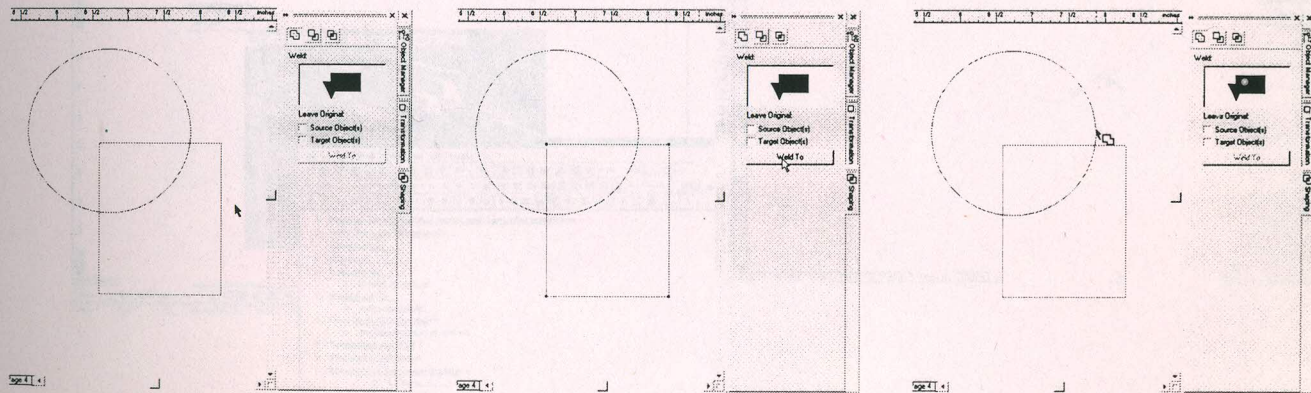
Constraints

Object - Action

Tool remains inactive if there is no object selected

Tool activates when the right type of geometry is selected

The cursor takes the shape of the tool, and the action is executed only when right geometry is clicked.

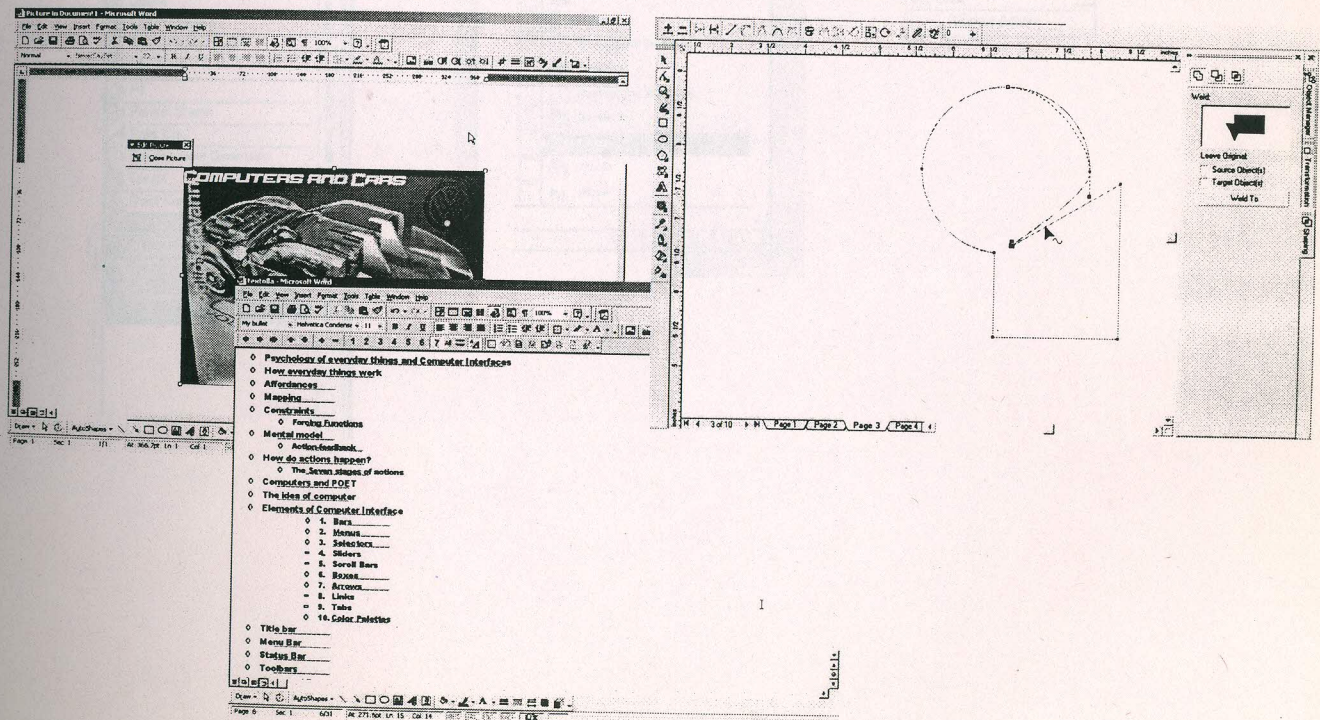


Modes

Various Modes enable only a type of activity to happen....e.g. an image mode, a tools mode and outline mode.

The unavailable options are dimmed.

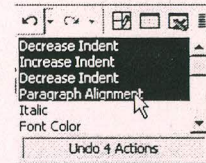
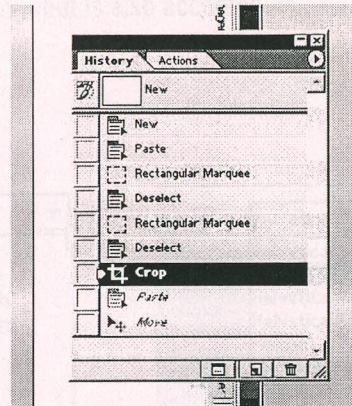
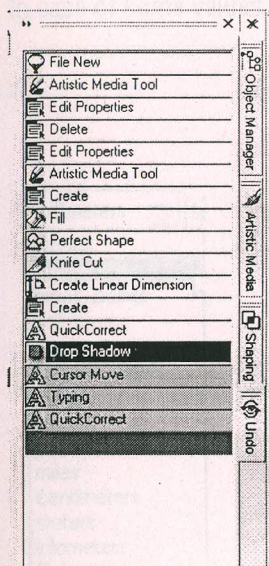
Saving in PowerPoint dims the undo icon signifying all the changes have been embedded (but the floppy icon for save is not dimmed)



History

Undo is unidirectional.....

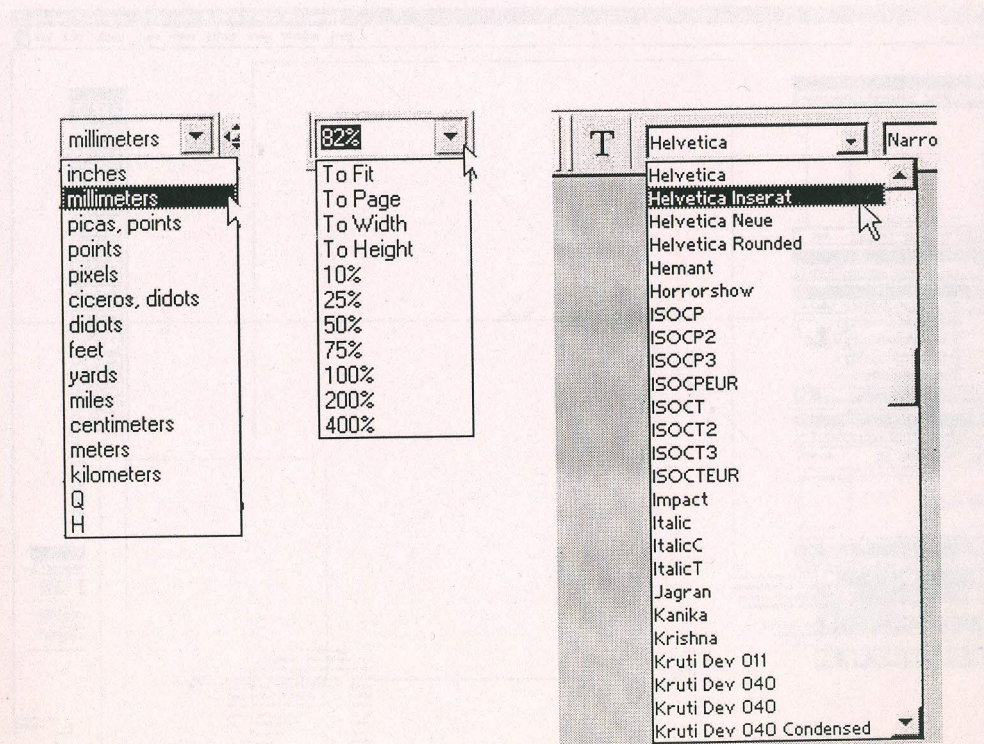
In word all the fields are selected as mouse moves down.



Combo Boxes

Combo Boxes constrain the input in form of pre-defined text or value.

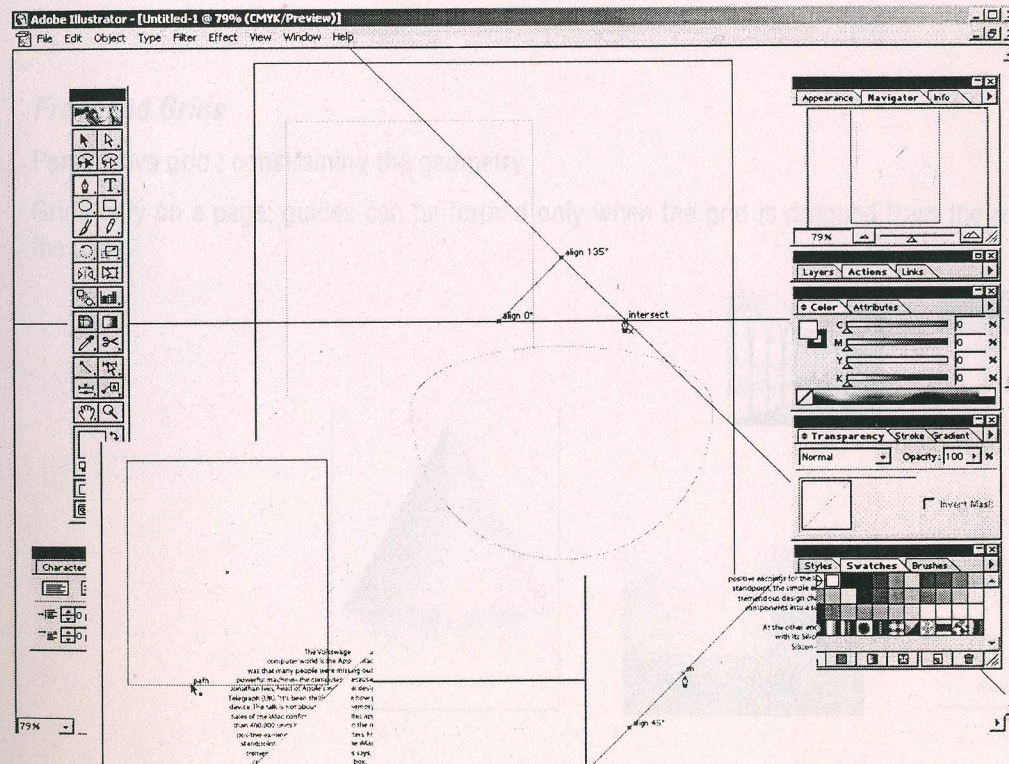
In case of some values, keyboard input is also accepted.

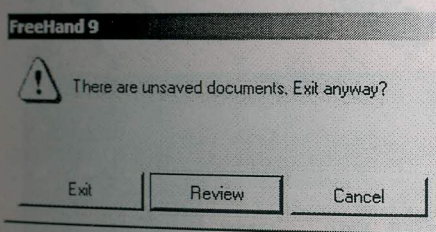
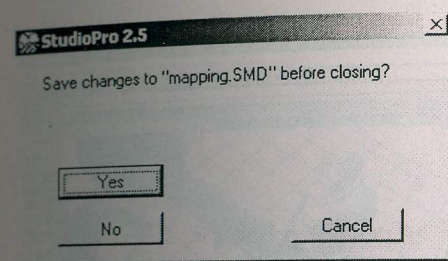
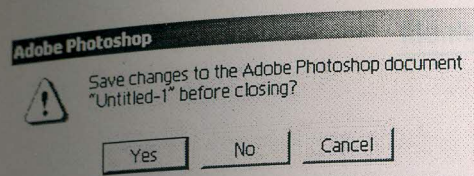


Drawing

Real time tracking of cursor showing possible geometric orientation and alignment

Also, when the cursor is taken over any geometry, its name is highlighted





Termination

Usual termination screen is yes no and cancel, which is mapped so well that people may do it involuntarily. The change of position causes the user to pay more attention.

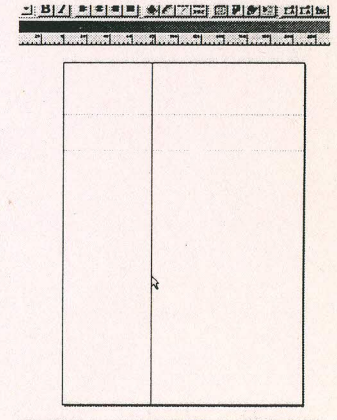
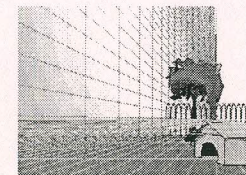
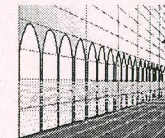
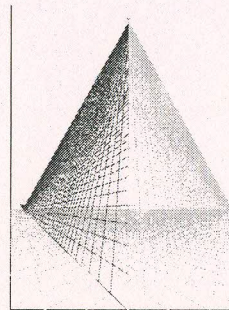
In freehand clicking 'review' takes to another dialog box irrespective of number of saves done earlier.

In rest, clicking 'yes' will open another dialog box only if the document has not been saved at all.

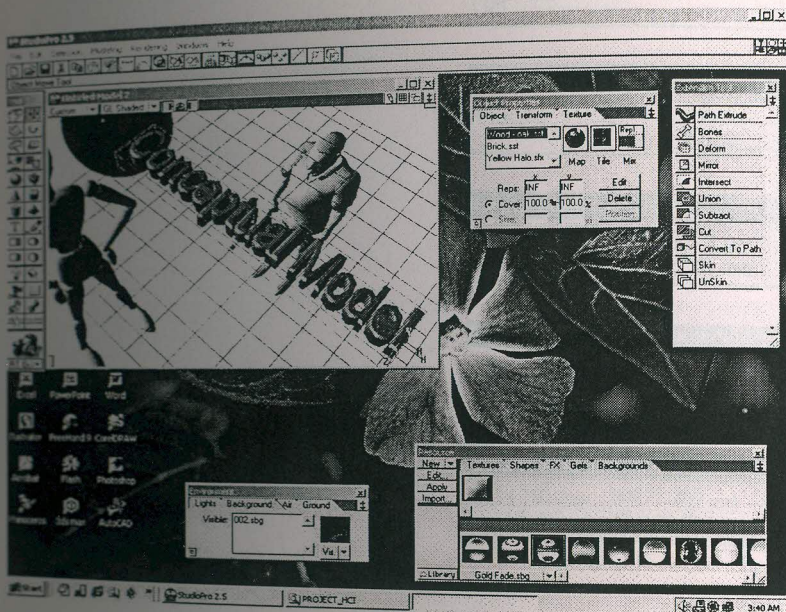
Freehand Grids

Perspective grid : constraining the geometry

Grids only on a page: guides can be formed only when the grid is dragged from the ruler ON the page.



Mental Model

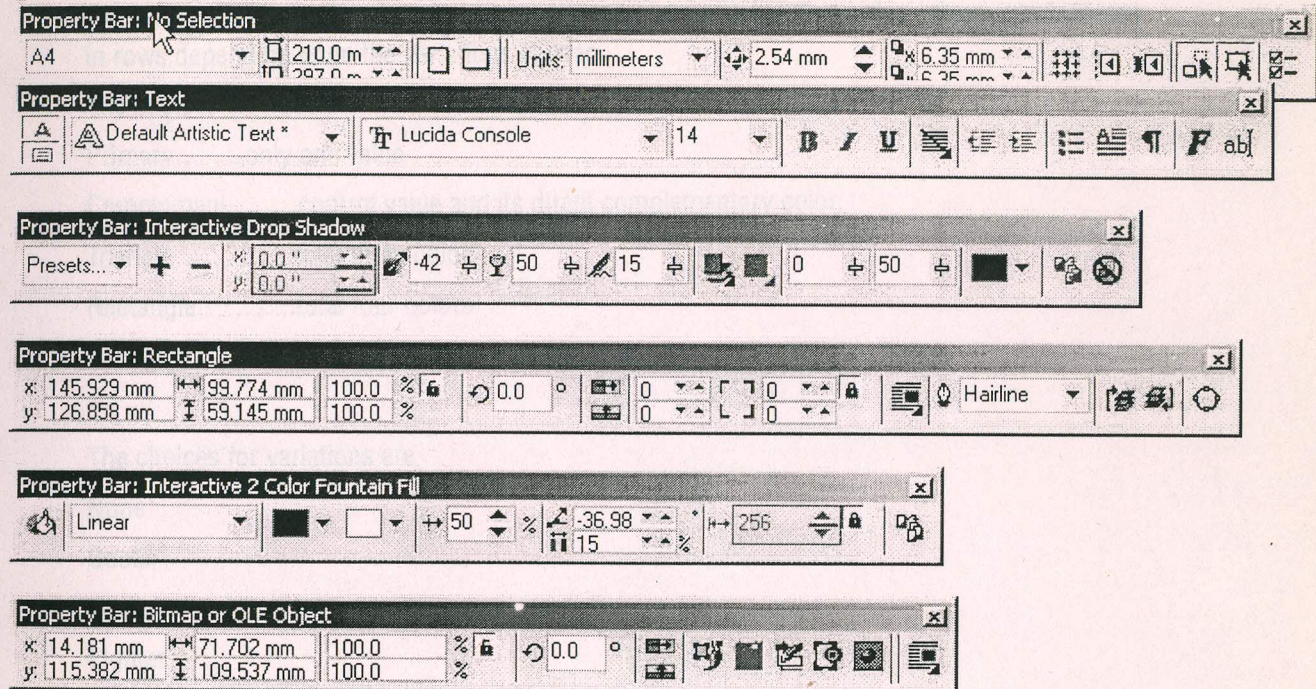


Strata Interface illustrating apple model of desktop.

Various files and folders are strewn on desktop and desk is visible through them.

Strata interface uses the conceptual models of 'menu bar' 'command-bar-like status bar' 'toolbox' and 'panels'

Same Place



Property bar is provides a mental model of changing tools and their settings.

Employs various conceptual models of all kind of widgets.

Photoshop 6 also introduced a bar named 'options bar'

Color Pickers

Constitutes understanding of multiple components so as to be able to understand the overall working.

The pentagon shaped picker helps picking 5 colors for palette. These five colors are displayed in rows depending upon the variations chosen.

The choices for hues are

Primary.....only one value

Complement.....control value and its direct complementary color.

Triangle.....total three colors

Rectangle.....total four colors

Pentagon.....total five colors

The choices for variations are

None

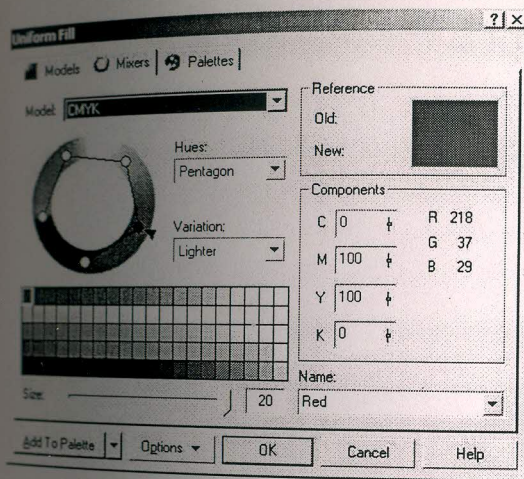
Cooler

Warmer

Lighter

Darker

Less saturation



Organization

Layer as a concept model in Photoshop 6

Layer and Hierarchy as a model in Corel draw 10

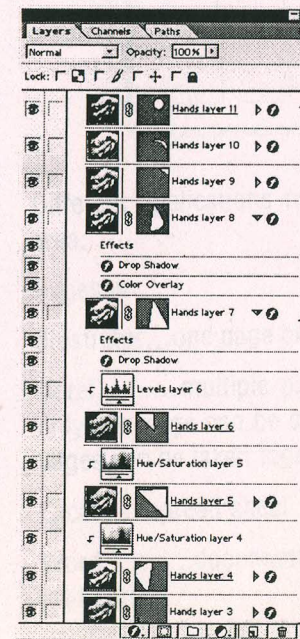
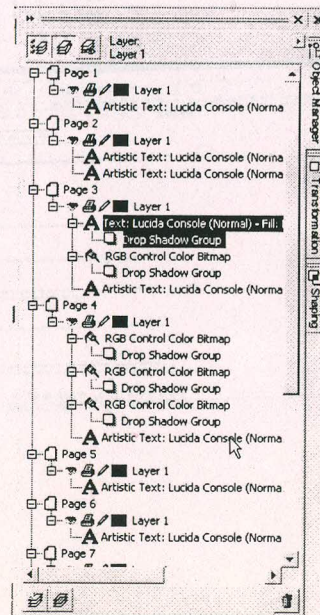
CorelDraw 10

Layers on each page....and multiple hierarchy in objects within the page.

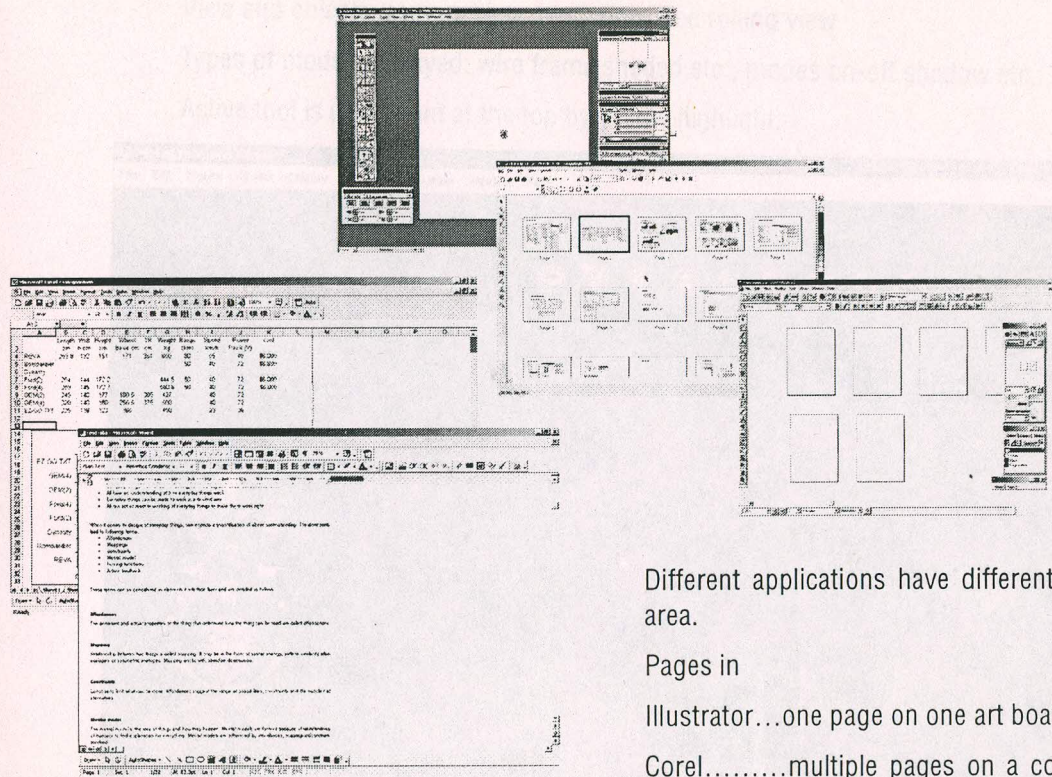
Photoshop 6

Concept of 'adjustment layer'

'Layer effects' and 'adjustment layer' given same level.



Pages



Different applications have different concept of working area.

Pages in

Illustrator...one page on one art board

Corel.....multiple pages on a common art board.but only one page can be seen on art board at a time,no two pages can be taken together.

Excelspread sheet

Word.....document, continuous pages without any art board.

Freehand.....all pages on same art board

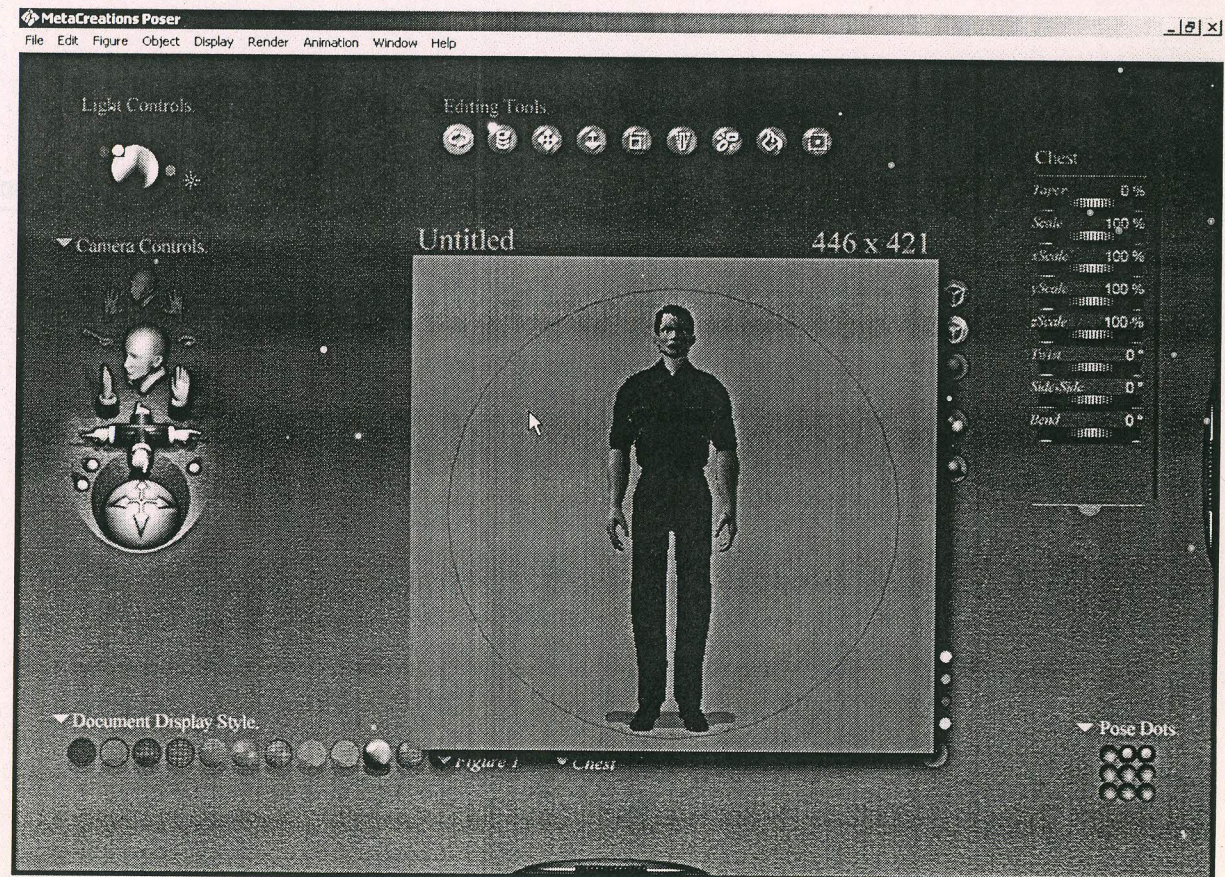
Poser Interface provides a mental model based on 3D icons for

Light adjustment: moving- panning, moving in one direction, moving freely

View and objects: camera view, rendering, free rolling view

Types of model displayed: wire frame shaded etc., modes on-off shadow etc.

Active tool is prominent at the top by yellow highlight.



Bibliography

“Design of Everyday Things”, by Donald A. Norman, First MIT press edition, 1998