

COMS W4170

Direct Manipulation 2

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October 25, 2018

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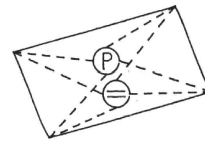
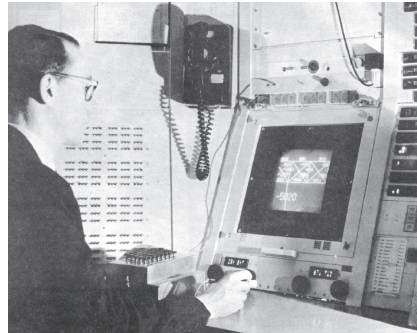
WIMP Interfaces

- User interfaces based on a combination of
 - **W**indows
 - **I**cons
 - **M**enus (or **M**ice)
 - **P**ointing

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History: 60s

- Ivan Sutherland, *Sketchpad*, 1963
 - First direct manipulation UI
 - First CAD system
 - First use of graphical “instances”
 - First use of graphical constraints



Extended to 3D

<https://www.youtube.com/watch?v=FuKREmsiD9o>
<https://www.youtube.com/watch?v=hB3jQKGrJo0>
<https://www.youtube.com/watch?v=t3ZsiBMnGSg>

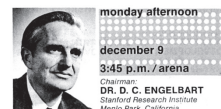
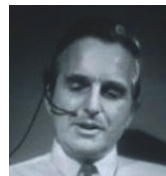
<http://www.cl.cam.ac.uk/TechReports/UCAM-CL-TR-574.pdf>

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History: 60s

- SRI Augmentation Research Center (Doug Engelbart)—NLS
 - Text processing
 - Mouse
 - Windows
 - Hypertext links
 - 1968 Fall Joint Computer Conference Demo

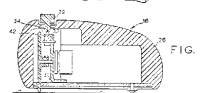
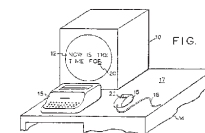
<http://sloan.stanford.edu/MouseSite/1968Demo.html>



a research center
for augmenting human
intellect

This session is entirely devoted to a presentation by Dr. Engelbart on a computer-based, interactive, multi-console display system which is being developed at Stanford Research Institute under the sponsorship of AFOSR, NASA and RADAC. The system is being used as an experimental laboratory for investigating principles by which interactive computer aids can augment intellectual capability. The techniques which are being described will, themselves, be used to augment the presentation.

The session will use an on-line, closed circuit television hook-up to the SRI computing system in Menlo Park. Following the presentation remote terminals to the system, in operation, may be viewed during the remainder of the conference in a special room set aside for that purpose.



US Patent 3,541,541

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Doug Engelbart, 60s–70s



<http://dougengelbart.org/library/engelbart-archives.html>

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Doug Engelbart, 60s–70s



<http://dougengelbart.org/library/engelbart-archives.html>

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Doug Engelbart, 60s–70s



<http://dougengelbart.org/library/engelbart-archives.html>

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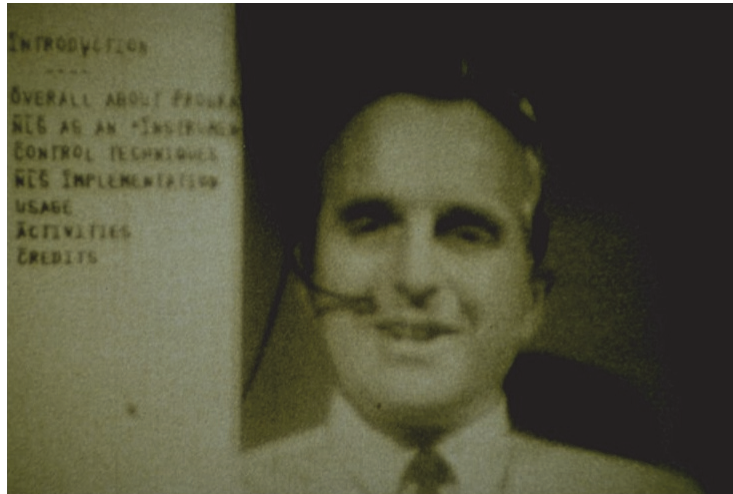
Doug Engelbart, 60s–70s



<http://dougengelbart.org/library/engelbart-archives.html>

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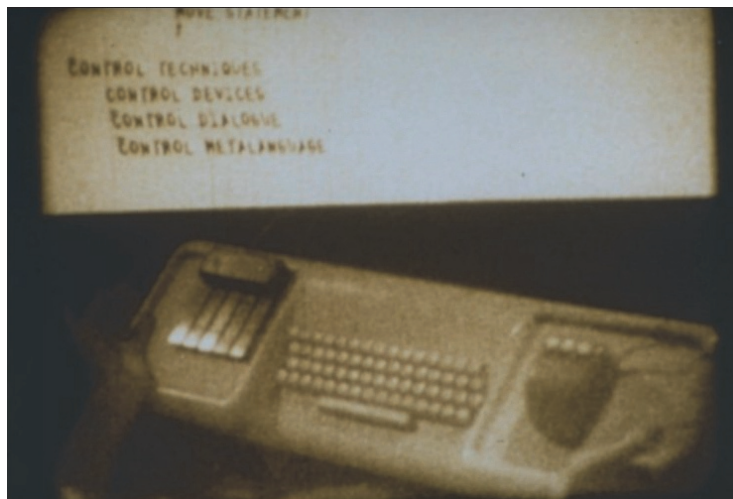
Doug Engelbart, 60s–70s



<http://dougengelbart.org/library/engelbart-archives.html>

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Doug Engelbart, 60s–70s



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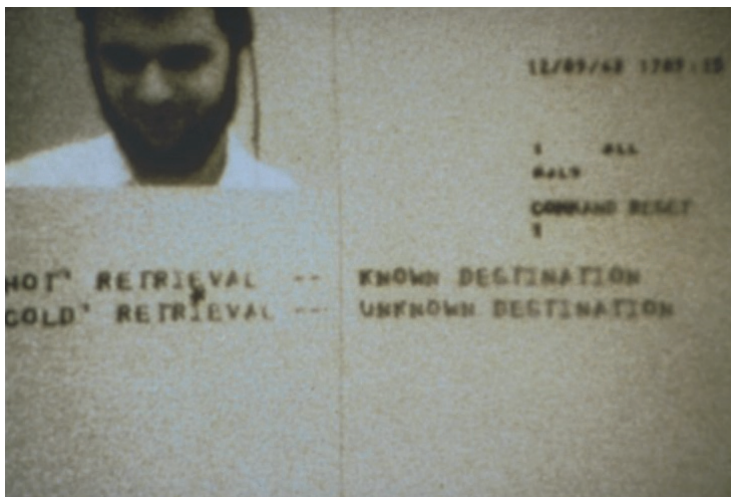
Doug Engelbart, 60s–70s



<http://dougengelbart.org/library/engelbart-archives.html>

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Doug Engelbart, 60s–70s

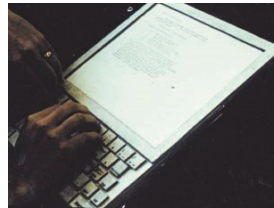


<http://dougengelbart.org/library/engelbart-archives.html>

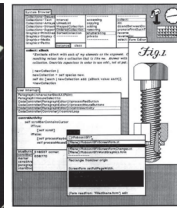
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History 70s

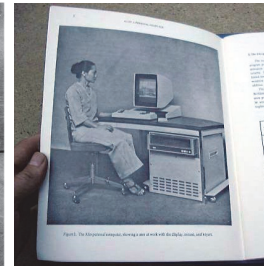
- Xerox Palo Alto Research Center (PARC)
 - Alan Kay, Dynabook
 - Late 60s pre-PARC dream of "a portable interactive personal computer, as accessible as a book"
 - C. Thacker et al., Alto, 73
 - The first bitmap display "personal computer"
 - The Alto, running Smalltalk, was treated as the "interim dynabook"



Kay, Dynabook cardboard mockup, 68



Xerox Alto



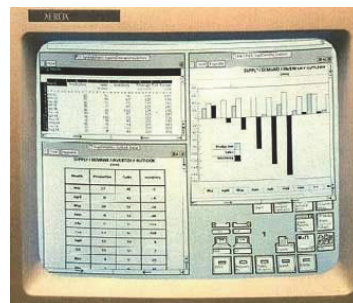
Xerox Alto

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History: 80s

- Workstation vendors 80s
 - Xerox Star, 81
 - Three Rivers Perq, 81
 - Apollo, 80

In the early 80s, R. Reddy (CMU) popularized the idea of the *3M computer*: the "ideal" research workstation with 1 MIP CPU, 1 MB RAM, and 1 M pixel display



Xerox Star

- Apple 80s
 - Lisa, 83
 - Pulldown menus, clipboard
 - Macintosh, 84
 - Drag and drop



Apple Lisa



Apple Macintosh

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Spreadsheets

The Original “Killer App”

- Killer App
 - An application so compelling that people buy the technology just to run it
- Visicalc (Dan Bricklin and Bob Frankston, 1979)
 - Inspired by paper spreadsheets used in business school
 - Dynamic recalculation
 - End-user programming
 - Apple II, 48K RAM



<http://www.bricklin.com/visicalc.htm>

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Explaining the Advantages/ Appeal of Direct Manipulation

- Feeling of direct involvement (instead of communicating through an intermediary)
 - Principle of transparency
 - “The user is able to apply intellect directly to the task; the tool itself seems to disappear.” (C. Rutkowski, Byte, 1982)
 - Rapid input → rapid incremental (in the limit, continuous) feedback
- Advantages of precise (typically manual) control
- Advantages of mapping to and interacting with a perceptible spatial (typically visual) representation
 - Bridges Norman’s gulfs of execution/evaluation
 - Offers perceptible (typically visually perceived) *affordances*

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Affordances Gibson, 1979



- “The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. The verb to afford is found in the dictionary, but the noun affordance is not. I have made it up. I mean by it something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment...

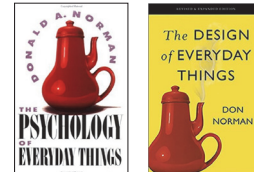
If a terrestrial surface is nearly horizontal (instead of slanted), nearly flat (instead of convex or concave), and sufficiently extended (relative to the size of the animal) and if its substance is rigid (relative to the weight of the animal), then the surface affords support...

Note that the four properties listed—horizontal, flat, extended, and rigid—would be physical properties of a surface if they were measured with the scales and standard units used in physics. As an affordance of support for a species of animal, however, they have to be measured relative to the animal. They are unique for that animal. They are not just abstract physical properties.”

— J. Gibson. *The Ecological Approach to Visual Perception*, 1979

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Affordances Norman, 1988 (Reinterpreted as “Perceived Affordances”)



- “When used in this sense, the term *affordance* refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. A chair affords (“is for”) support, and, therefore, affords sitting. A chair can also be carried. Glass is for seeing through and for breaking.”

— D. Norman. *The Psychology of Everyday Things*, 1988

“I introduced the term affordance to design in my book.... The concept has caught on, but not always with true understanding. Part of the blame lies with me: I should have used the term “perceived affordance,” for in design, we care much more about what the user perceives than what is actually true....

In graphical, screen-based interfaces, all that the designer has available is control over perceived affordances....

[I]t is wrong to argue whether a graphical object on the screen “affords clicking.” It does. The real question is about the perceived affordance: Does the user perceive that clicking on that location is a meaningful, useful action to perform?”

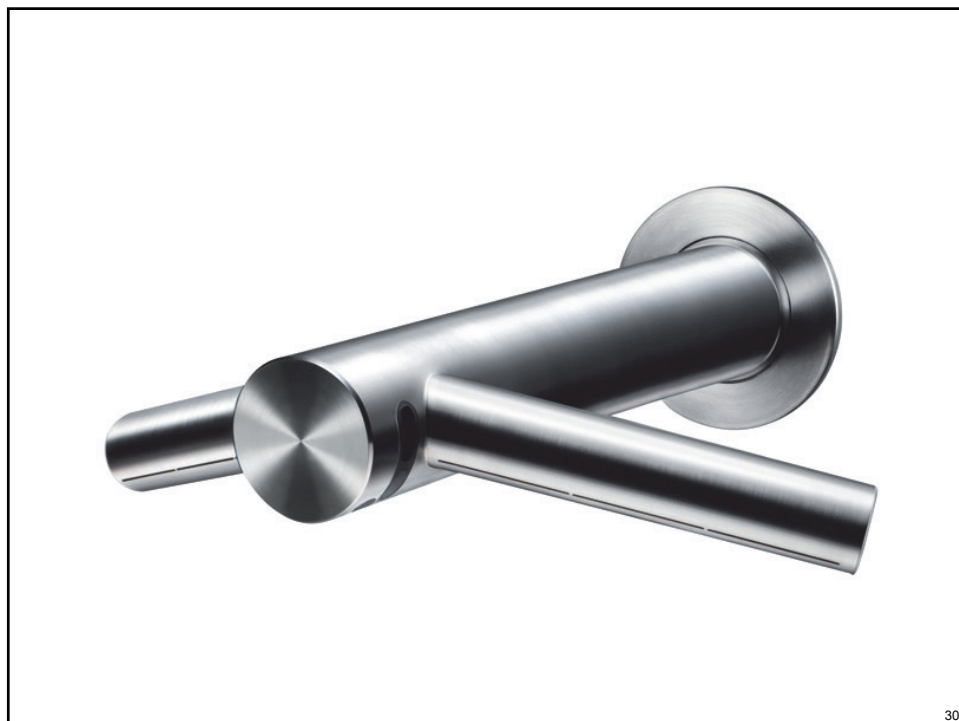
— D. Norman. http://www.jnd.org/dn.mss/affordances_and.html

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Perceived Affordances

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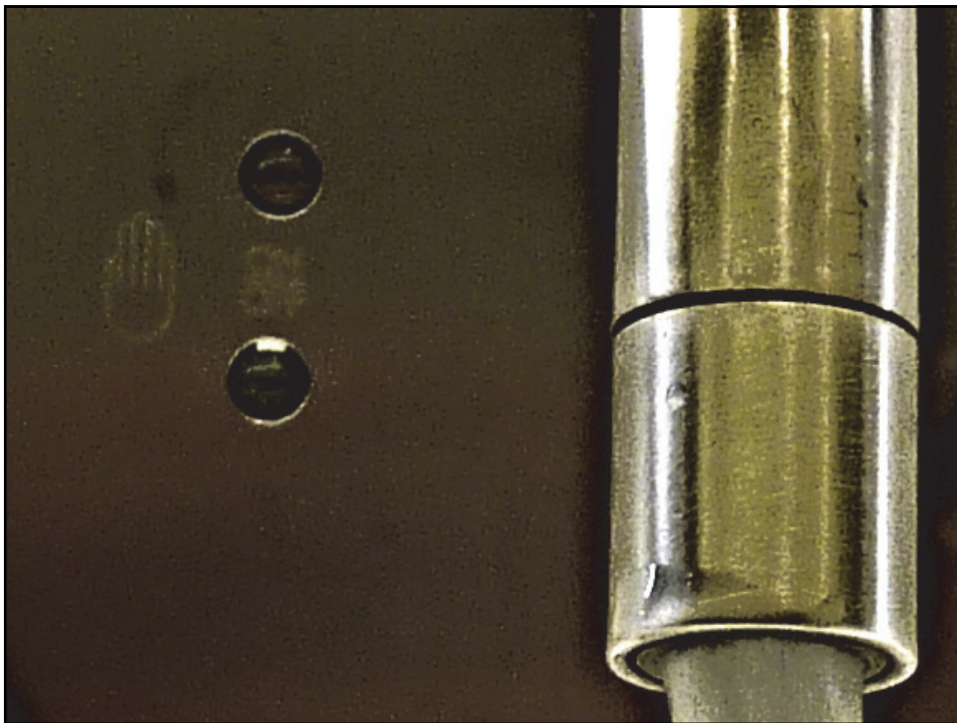




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Challenges for Direct Manipulation

- Big spatial representations
 - Take up lots of space → Big displays, high-res displays, multiple displays
 - Zooming/panning → Time consuming
- Small screens / fat fingers
 - Selection difficulty
 - Screen blocking
- Homing time between devices
- Time/effort to design (choosing objects, actions, metaphors)
- Time/effort to learn
- Increased complexity for disabled users
 - Screen reader issues
 - Dexterity issues
- Simple devices → simple manipulations
 - Mouse = “dog’s paw” (Stu Card)
- Some tasks don’t map well to obvious manipulative actions

