Announcements

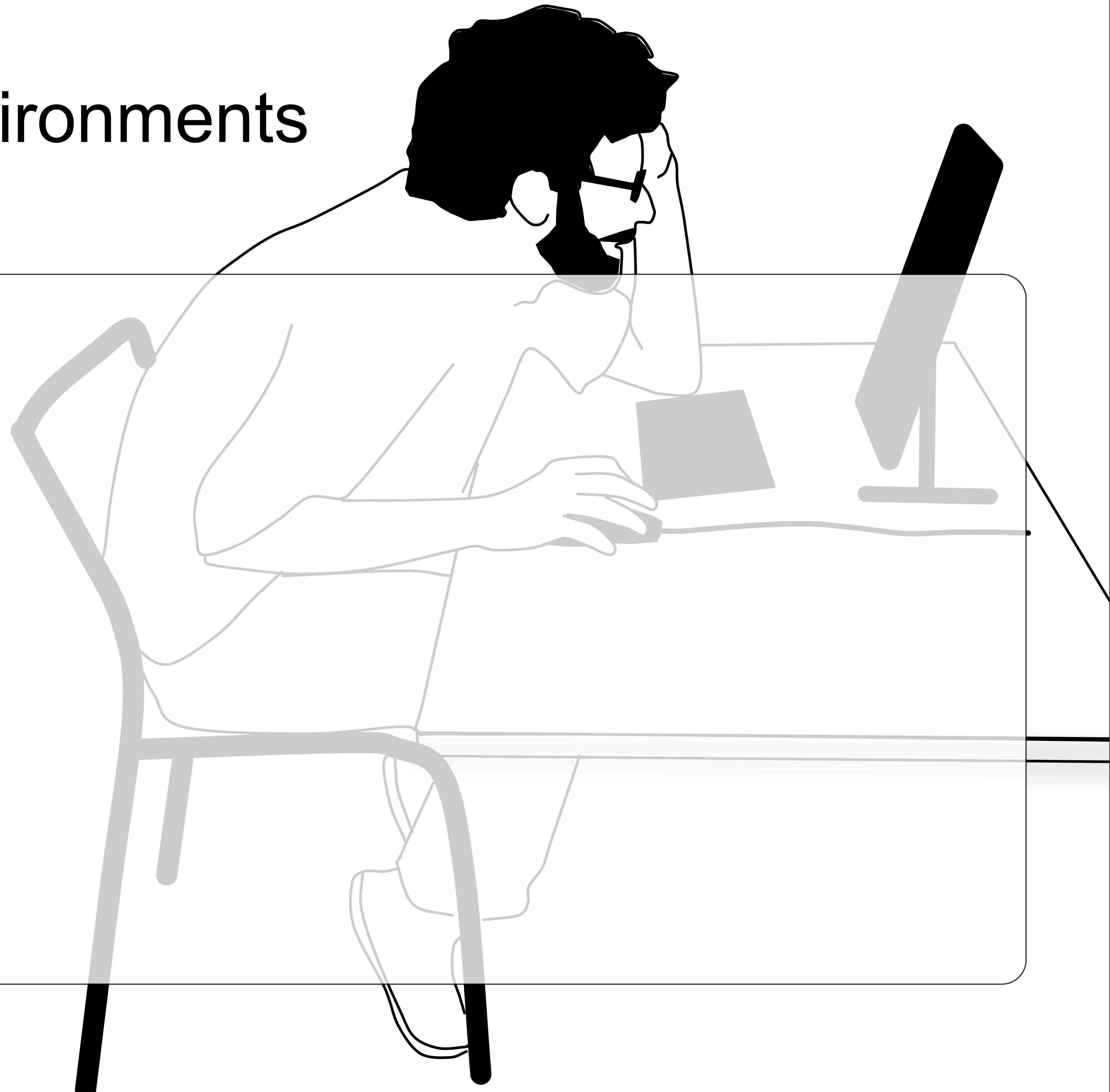
- we will decide on a winner of assignment 1 in the coming days.
- perform next exercise as group of four
  - with individual submissions (explained in the assignment)
- explore real-world problems
  - interview
  - sign a consent for audio recordings!
- create solutions/ideas
  - brainstorming
  - selection of a limited number of ideas
- communicate your idea and act it out
  - video prototyping
- related work will help you
- I will be the next two weeks in the exercises to give you feedback on your work.

Let's recap

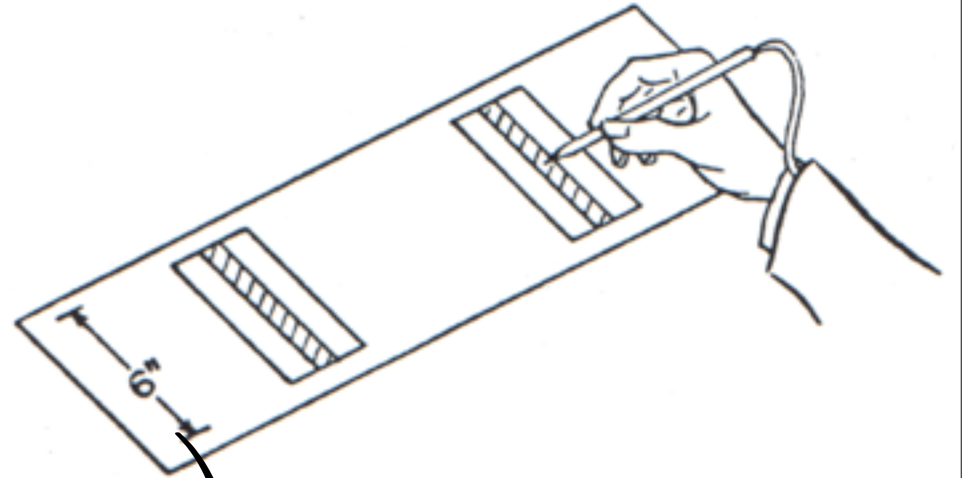
- timeline of input technologies
  - desktop input devices
  - of people thinking *out-of-the-box*
- strategy of how people work
  - trial-and-error vs. instead of "knowing your problem very well"
  - designer: step-by-step, do not know what the problem is and how to solve it, cooperation between user and computer, like human assistant
  - old way: understand problem, know steps to solve, computer is elaborated calculating machine

Desktop Environments

- context and task
- challenges
- input technologies
- **challenges in interaction design**
- output technologies



Pointing - Fitts’ Law



$$MT = a + b \log_2\left(\frac{D}{W} + 1\right),$$

- a, b vary according to nature of acquisition task, the kind of motion performed or the muscles used.
- visual/display space and motor/control space

Pointing - Fitts' Law

$$MT = a + b\log_2\left(\frac{D}{W}+1\right),$$

- D = distance to target
  - D_m - motor space, D_v - virtual space
- W = width of target
  - target width vs. effective target width

$$CDgain = \frac{V_{pointer}}{V_{device}}$$

- control-display gain
  - gain < 1: display pointer moves slower, covering less distance than the control device
  - gain > 1: display pointer moves proportionality farther and faster than the control device cursor movement.
- goal: decrease MT!
- how?

Drag-and-pop - ‘*decrease D*’

- Idea: temporarily bringing virtual proxy of the most likely potential set of targets towards the cursor.
- originally designed for desktop icons
- challenges if applied to other elements?
  - proxies overlay
  - occlusion of valuable information
  - selection of targets in distance or vicinity
  - calm visual design to avoid annoyance

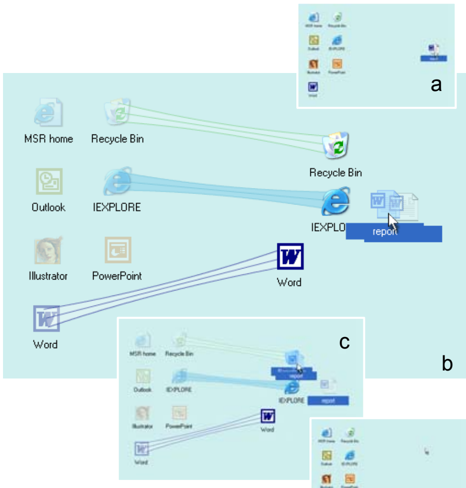
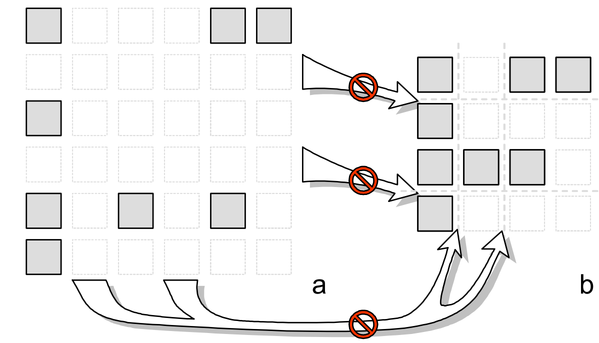


Figure 1: Drag-and-pop

Literature: Baudisch et al. Drag-and-Pop and Drag-and-Pick: Techniques for Accessing Remote Screen Content on Touch and Pen-operated Systems. In Proc Interact'03, pp. 57--64.

Drag-and-pop - ‘*decrease D*’

- Drag-and-pop’s candidate:
  - icons of compatible type
  - tip icons layout: snap icons to a grid, remove empty rows and columns
  - icons located within a certain angle from the initial drag direction.
  - if(no. of qualifying icons > limit)
    - eliminate tip icon candidates until hard limit is met starting from outside, going inwards.
- Results:
  - not significantly faster on desktop
  - advantage for very large screens



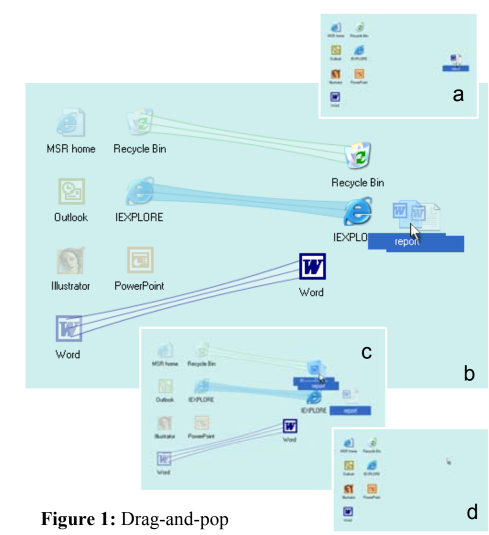


Figure 1: Drag-and-pop

Literature: Baudisch et al. Drag-and-Pop and Drag-and-Pick: Techniques for Accessing Remote Screen Content on Touch and Pen-operated Systems. In Proc Interact'03, pp. 57--64.

Object Pointing - ‘*decrease D*’

- Guiard et al. noted that in most real graphical user interface are a significant number of pixels serving no useful function other than providing a pleasing interface layout.
- 50 selectable object, 400 px size, 1600x1200 px display
  - how many pixels are “used”?
  - from a total of how many pixels?
- skip the “empty space”

Literature: Guiard et al., “Object pointing: a complement to bitmap pointing in GUIs”. 2004

Object Pointing - ‘*decrease D*’

- Idea: if cursor leaves a selectable object and its velocity exceeds a threshold, it jumps to the next available target.
  - advantages: 74% faster than regular pointing for a reciprocal pointing task.
  - disadvantages:
    - selection or manipulation of an individual pixel (text character in word processor)
    - tools are often tiled together
    - jumping motion might be annoying (controlled experiment vs. field study)

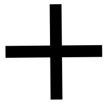
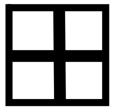
Literature: Guiard et al., “Object pointing: a complement to bitmap pointing in GUIs”. 2004

‘Increase W’

- fish-eye-dock menu in MacOS X
  - icons expand when cursor is over them.
    - advantage: effective use of screen real estate
    - disadvantage: occluding neighboring targets

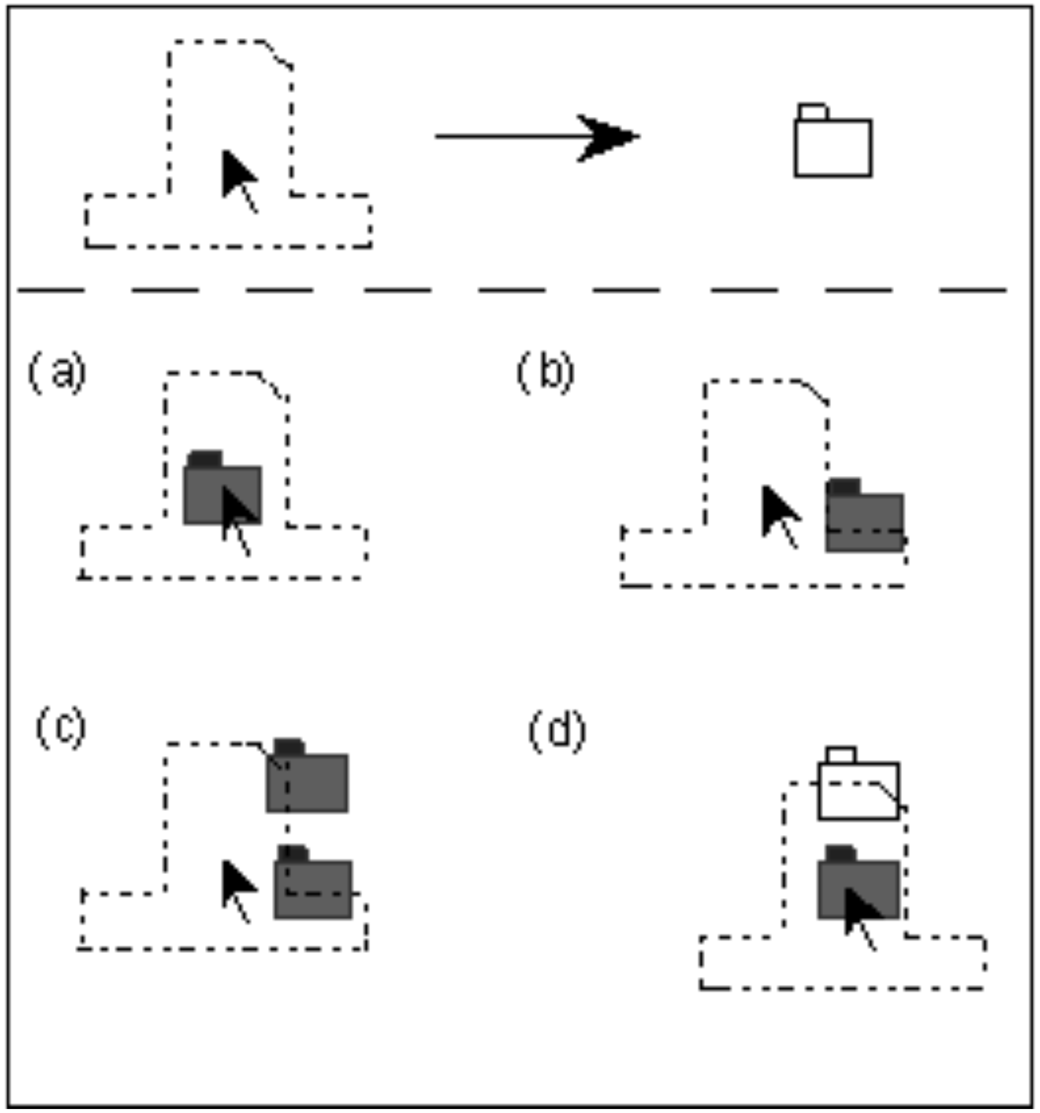
http://maxcdn.webappers.com/img/2008/03/fish-eye-dock-menu.png

Area Cursor - ‘Increase W’

Point cursor:  Area cursor: 

Literature: Kabbash et al., “The Prince Technique: Fitts’ Law and Selection Using Area Cursor”. CHI’95

Area Cursor - ‘Increase W’



“Why do people miss the Trash icon so often? Perhaps it’s because we’re attending to the file we’re moving, rather than the location of the pointer”

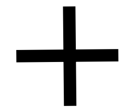
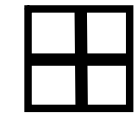
Literature: Kabbash et al., “The Prince Technique: Fitts’ Law and Selection Using Area Cursor”. CHI’95

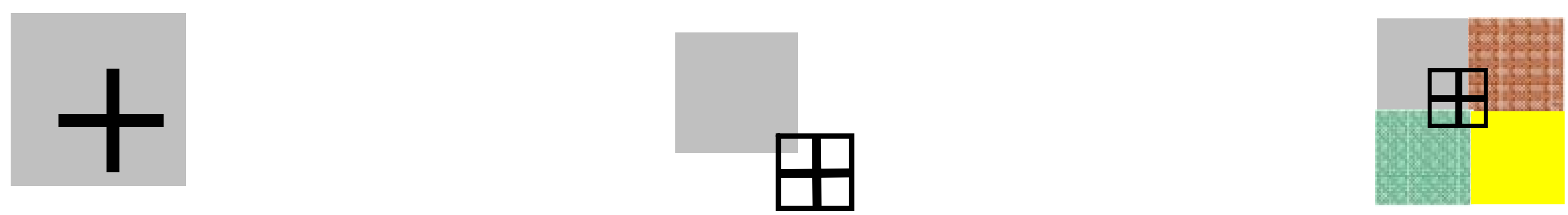
Area Cursor - ‘Increase W’

- area around the cursor, the so called ‘hot spot’, is larger than the single pixel of standard cursors.
  - advantage: easier to point to very small targets. ID of pointing task with area cursor is smaller than with point cursor.
  - disadvantage: target ambiguity with dense target groups.

Literature: Kabbash et al., “The Prince Technique: Fitts’ Law and Selection Using Area Cursor”. CHI’95

Area Cursor - ‘Increase W’

Point cursor:  Area cursor: 



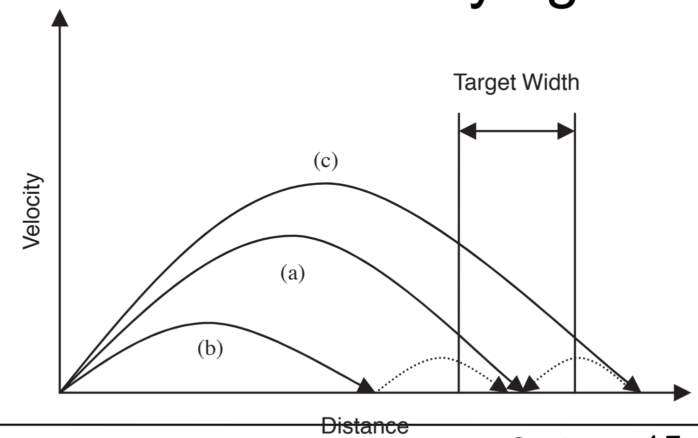
http://dl.acm.org/citation.cfm?id=1056159

- problem: ambiguity with dense target groups
- solution:cursor has two hot spots, (1) whole cursor area and (2) cursor point
  – if target far away, cursor behaves like area cursor, if more targets within area, it behaves like standard pointing.

Literature: Kabbash et al., “The Prince Technique: Fitts’ Law and Selection Using Area Cursor”. CHI’95

Semantic Pointing - ‘decreasing A’ **AND** ‘increasing W’

- dynamically vary the C-D gain, so called “mouse acceleration” techniques.
  – if user moves device fast, intents to cover large distance.
- adjust C-D gain based on knowledge about the targets (sticky targets).
  – idea: increase if cursor outside of targets, decrease when inside of target
- advantage:
  – significantly decreases target acquisition time.
  – in particular small targets and older people had more benefit with this technique.
- disadvantage:
  – ‘getting’ stuck when crossing other targets.
  – with small targets, movement to fast to trigger event for underlying widget.



Literature: Worden et al., “Making computers easier for older adults to use: area cursors and sticky icons”. CHI’97
Keyson et al. “Dynamic cursor gain and tactual feedback in the capture of cursor movements.”

Semantic Pointing - ‘decreasing A’ **AND** ‘increasing W’

(a)
(b)
(c)

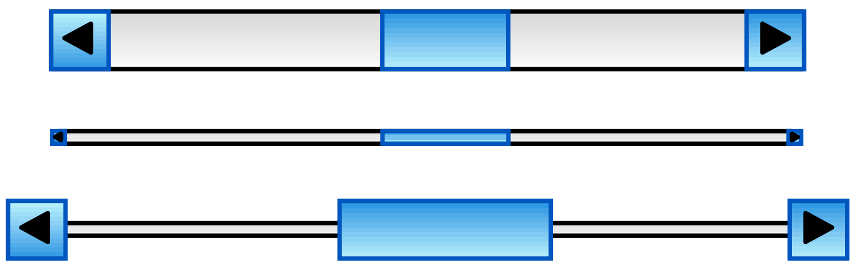
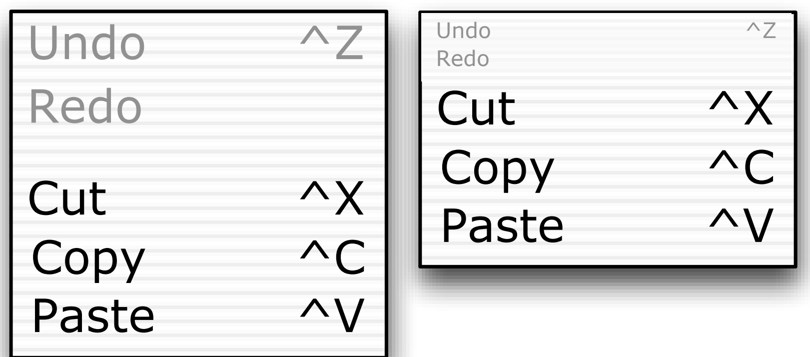


Figure 12: Scroll-bar redesign
(a) original version. (b) new version: visual space (what it looks like) and (c) motor space (what it feels like when interacting with it).



(a) (b)

Figure 13: Menu redesign
(a) unchanged visual version (b) motor space version

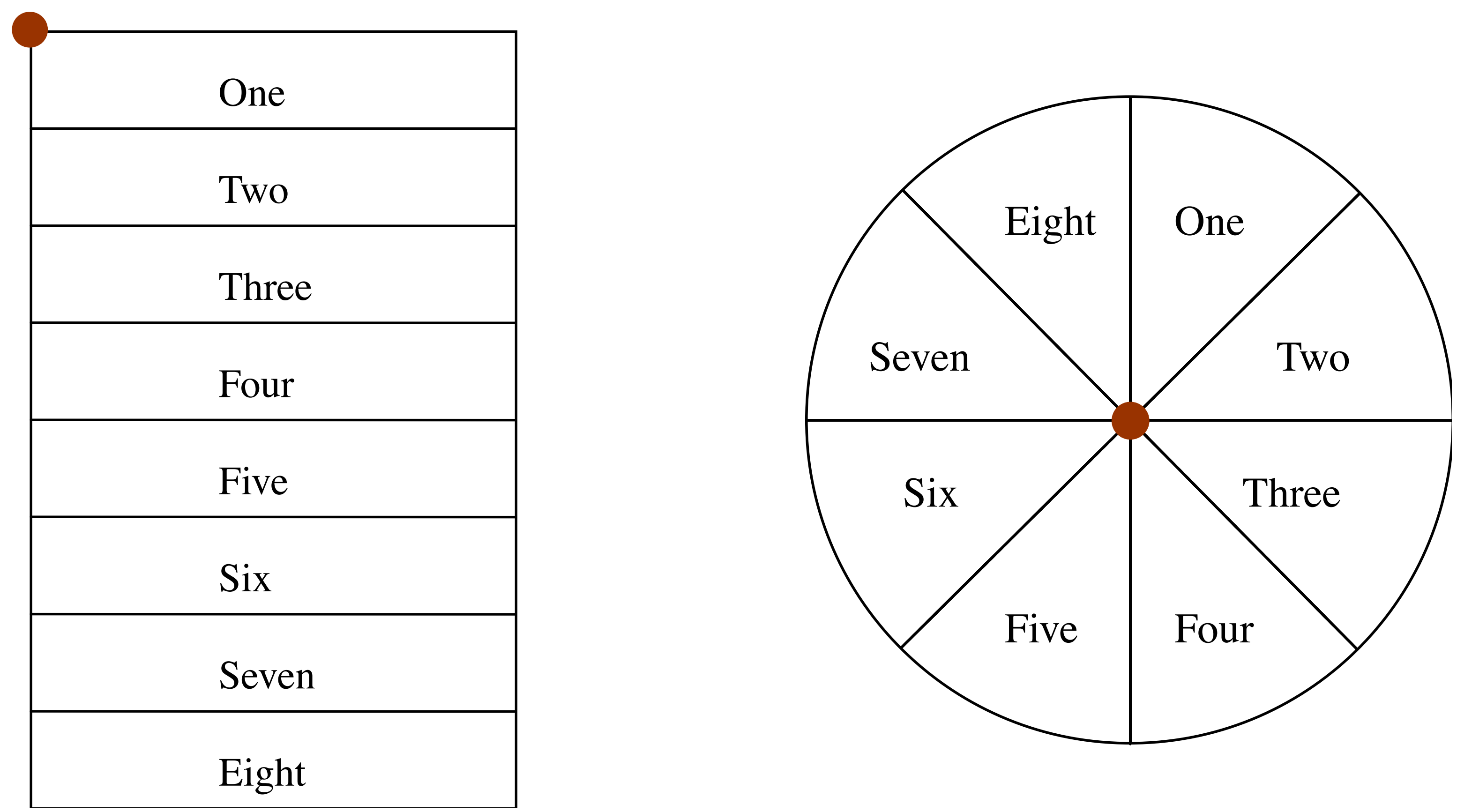
(a)
(b)

Figure 14: Button redesign
(a) unchanged visual version (b) motor space version

Pointing Techniques

- drag-and-pop
  - temporarily bring items to cursor
- object pointing
  - skip empty space between targets
- area cursor
  - pointing hot spot is larger than a pixel
- semantic pointing
  - dynamically vary C-D-gain

Importance for Menu Techniques



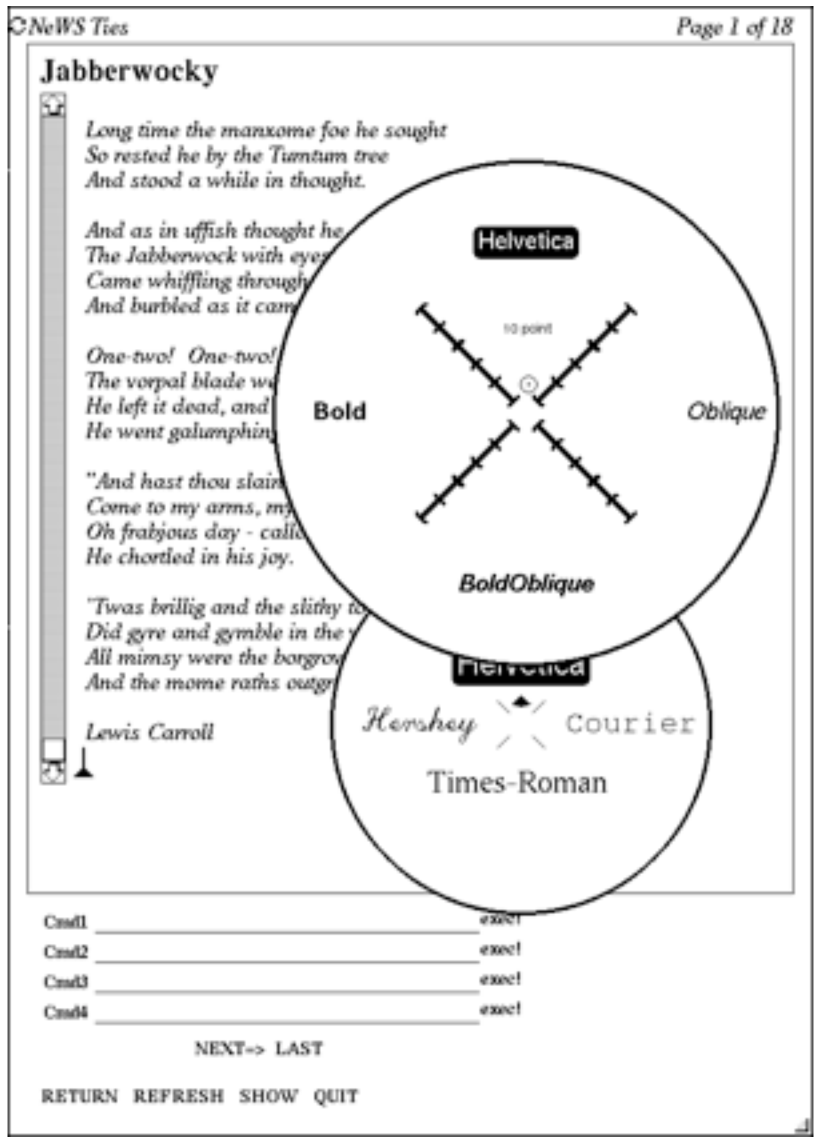
http://dl.acm.org/citation.cfm?id=1056159

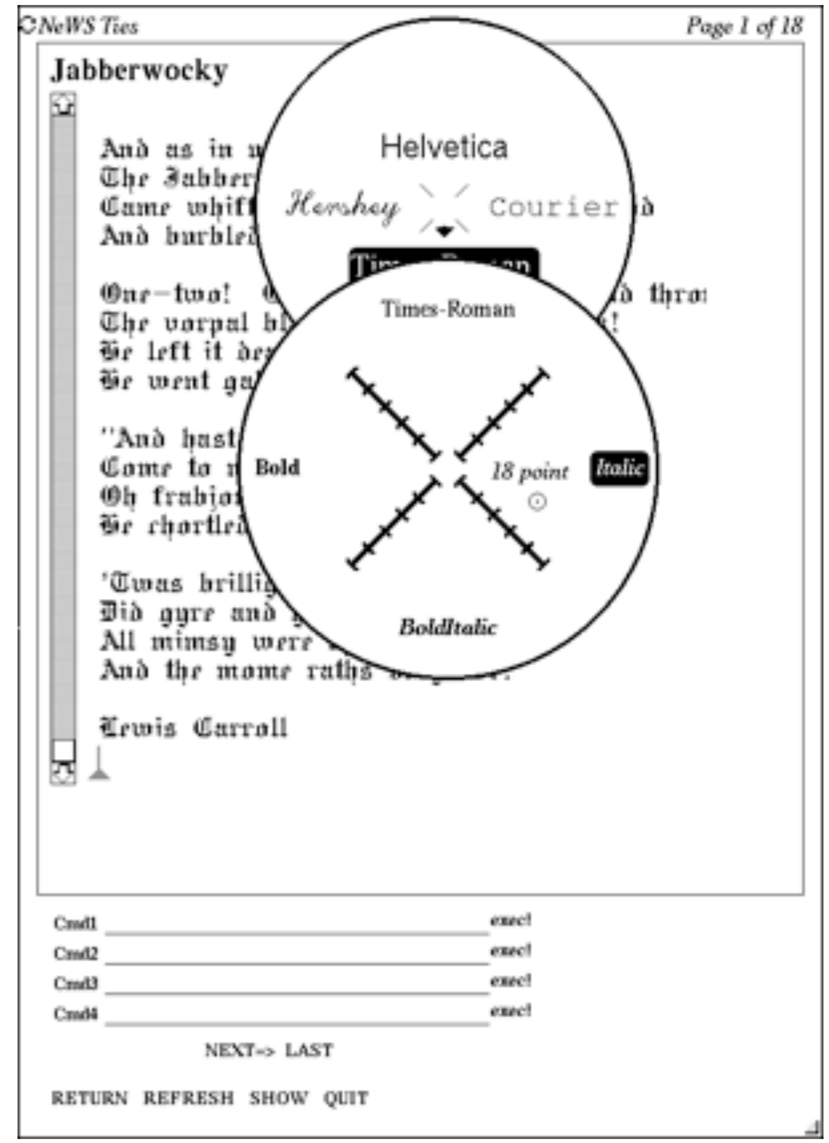
Pie Menus

- invokes a circular menu with a click. cursor is centered in small inactive region in the menu center. Move cursor to item and select it.
  - advantage:
    - placement in opposite directions for complementary items.
    - spatially oriented items can be put in their appropriate directions.
    - taking advantage of muscle memory
  - disadvantage:
    - requires more screen real estate than linear menus.
    - limited to 8 items
- Implemented in Sun Microsystem's NeWS window system and MIT's X windows windows management system.

Literature: Don Hopkins. "Pies:Implementation, Evaluation and Application of Circular Menus, Tech. Report, University of Maryland."

Don Hopkins' Pie Menu examples

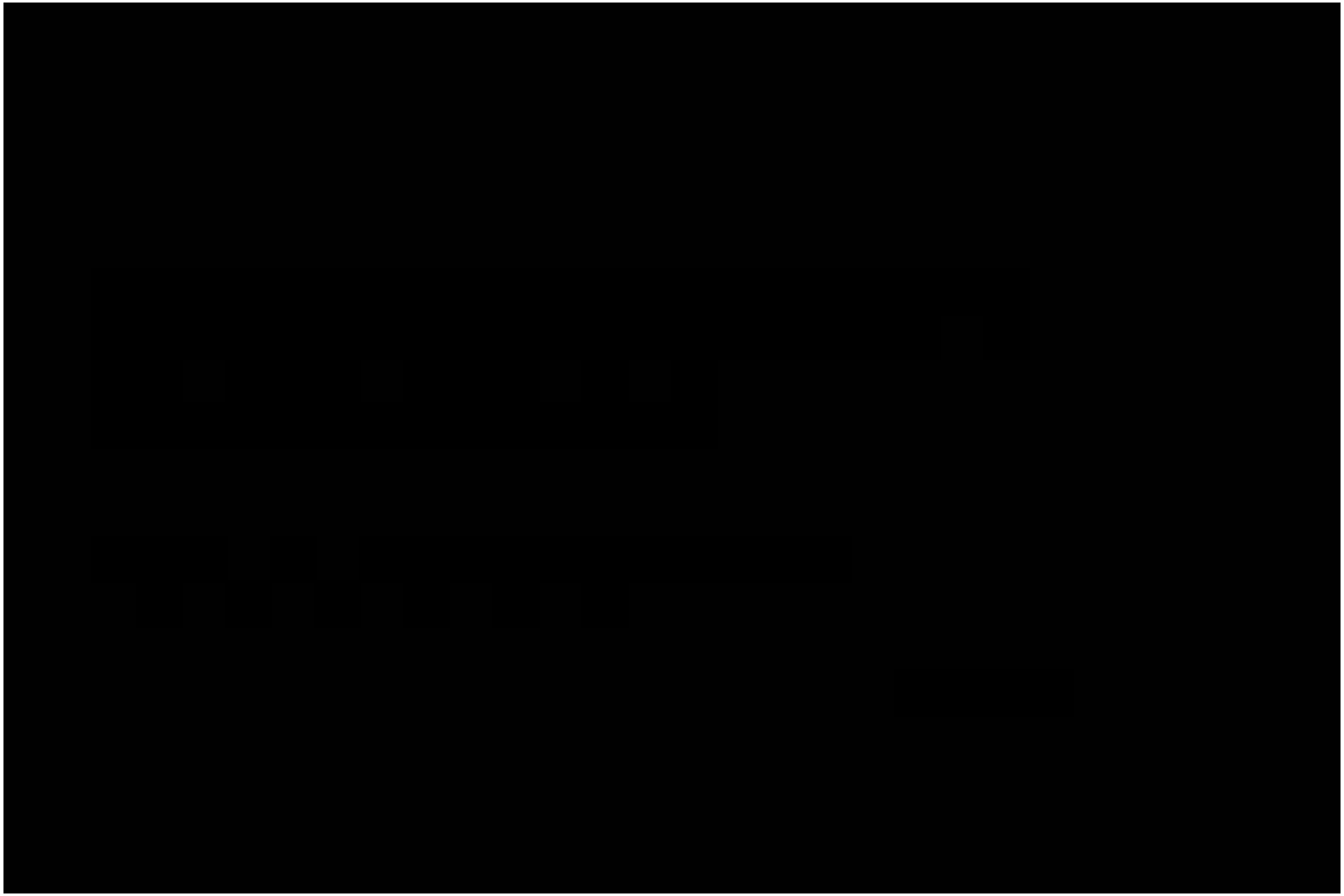




http://www.donhopkins.com/drupal/node/94

Literature: Don Hopkins. "Pies:Implementation, Evaluation and Application of Circular Menus.", , Tech. Report, University of Maryland

Marking Menus



http://www.youtube.com/watch?v=dtH9GdFSQaw

Marking Menus

- combination of pop-up radial menus and gesture recognition
- advantages:
  - scale independent of movements
  - less visually taxing
- disadvantage:
  - limited number of items (8 - 12 items)
- interesting concept: design transition from novice to expert mode.

Marking Menu Variations

- compound-stroke menu (hierarchical MM)
  - spatial composition of marks.
  - gesture performed continuously without releasing the mouse button.
  - problem: requires large physical input space, limited depth even for experts
- multi-stroke menu
  - temporal composition of marks
  - each elementary stroke completed with mouse release
  - problem: delay needed to determine if stroke belongs to previous sequence or starts new one.

Literature:
•Kurtenbach et al. “The limits of expert performance using hierarchical marking menus.” CHI’93
•Zhao et al. “Simple vs. compound mark hierarchical marking menus.” UIST’04

Desktop

context and task

challenges

input technologies

challenges in interaction design

Pointing

Menu

output technologies

http://www.youtube.com/watch?v=XtdOQWiVLXM

Marking Menu Variations

- zone and polygon menu
  - consider relative position and orientation of elementary strokes relative to origin the first mouse click.
    - position within a zone
    - position on a polygon
  - extending the breadth to 32/16 items

Literature:
Zhao et al. “Zone and polygon menus: using relative position to increase the breadth of multi-stroke marking menus.” CHI’06

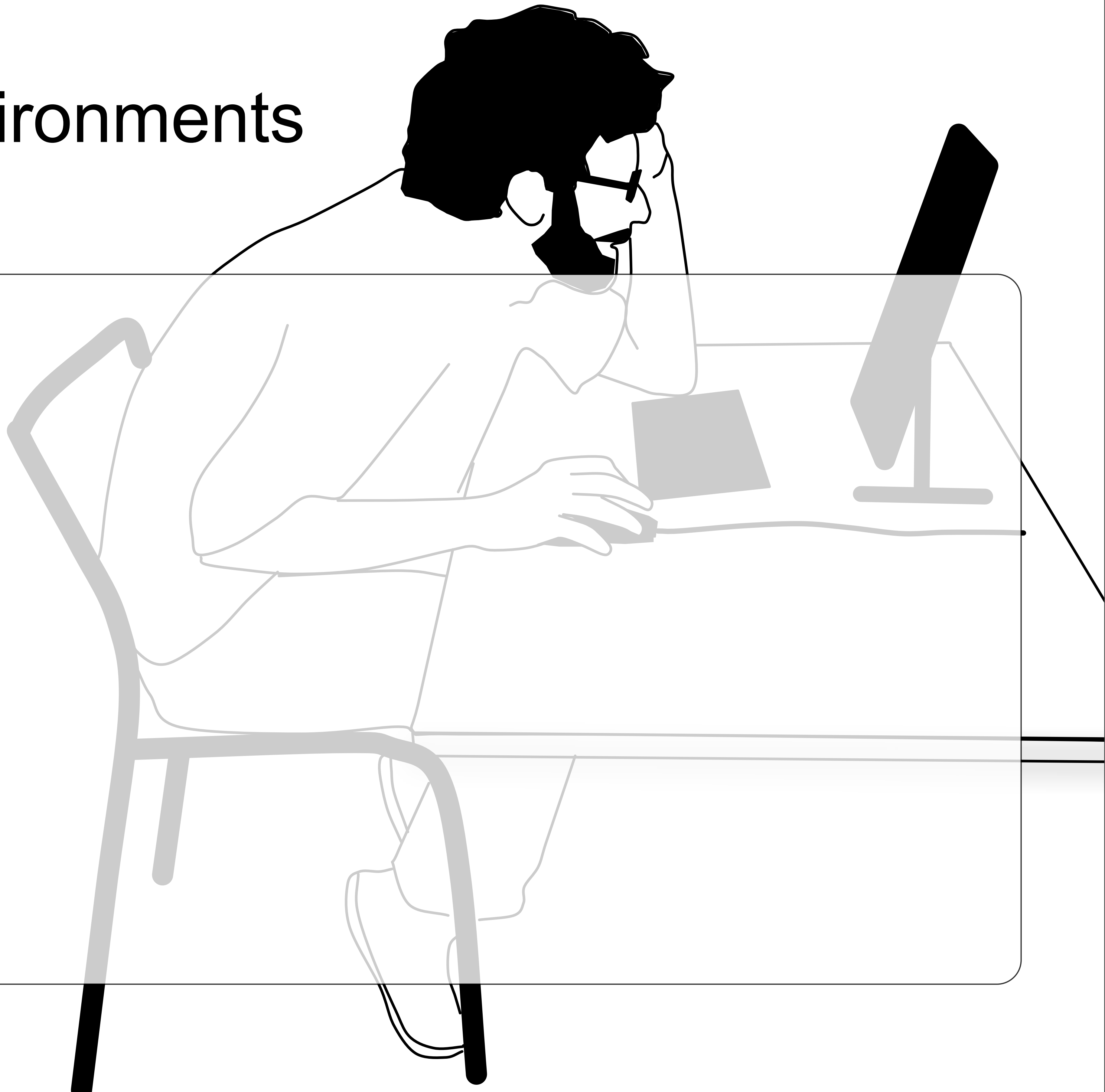
Menu techniques

- Pie Menus
  - ID equal for all items
- Marking Menus
  - limitations: max 12 items (acceptable error rate)
- Hierarchical marking menus: “zigzag” marks
  - limited to breadth-8, depth of 2 levels
- Multi-Stroke marking menus
  - temporal composition instead of spatial composition
- Zone and Polygon MM
  - relative position + angle

take-away message

- Models
  - inspire a whole set of novel techniques
  - opens a new perspective
    - e.g. the separation of motor vs. display space
  - apply knowledge to all other pointing devices similar to a mouse or understand the difference to other input devices to spark new techniques to enhance input.

Desktop Environments



- context and task
- challenges
- input technologies
- challenges in interaction design
- **output technologies**

- physical/tangible output
- display techniques
  - cathode ray tube
  - liquid crystal display
  - OLED (keyboard labels?)

1st generation of physical output

http://www.hp9825.com/assets/images/HP_9871A_Impact_Printer02.jpg

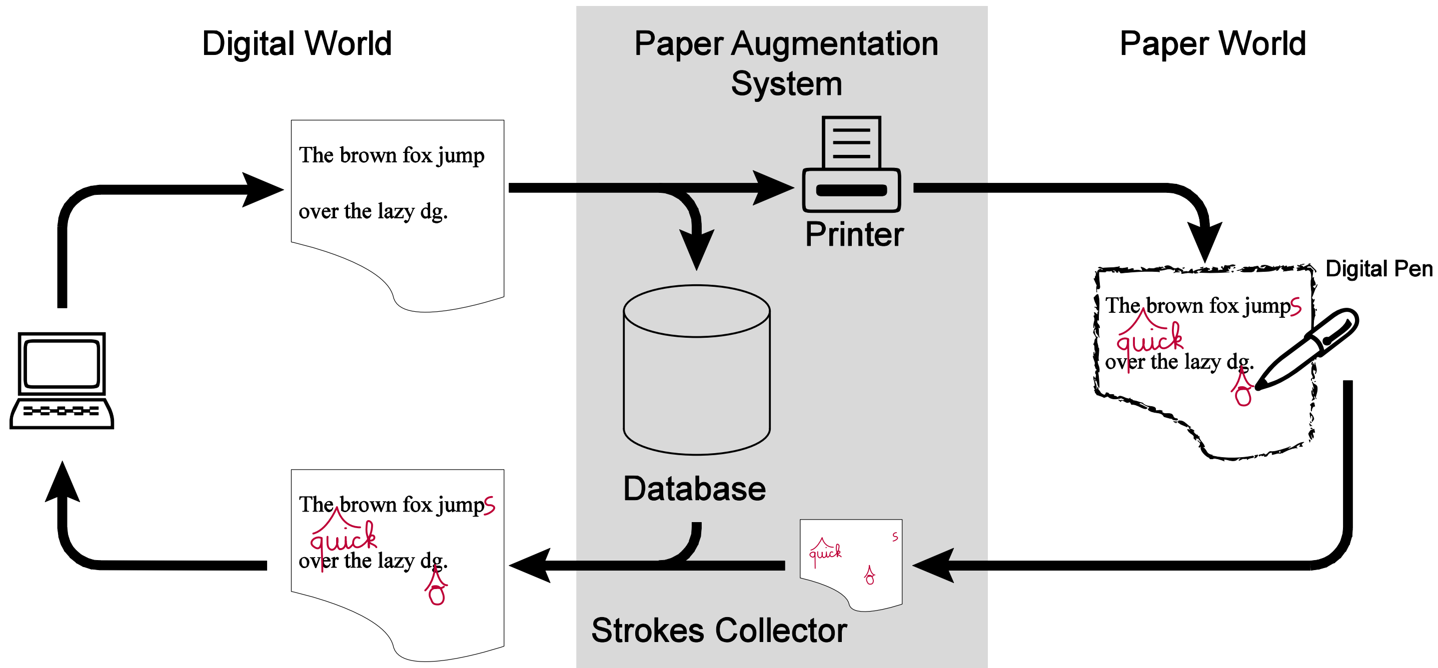
http://www.build-your-own-computer.net/image-files/computer-output-device-printer-01.jpg

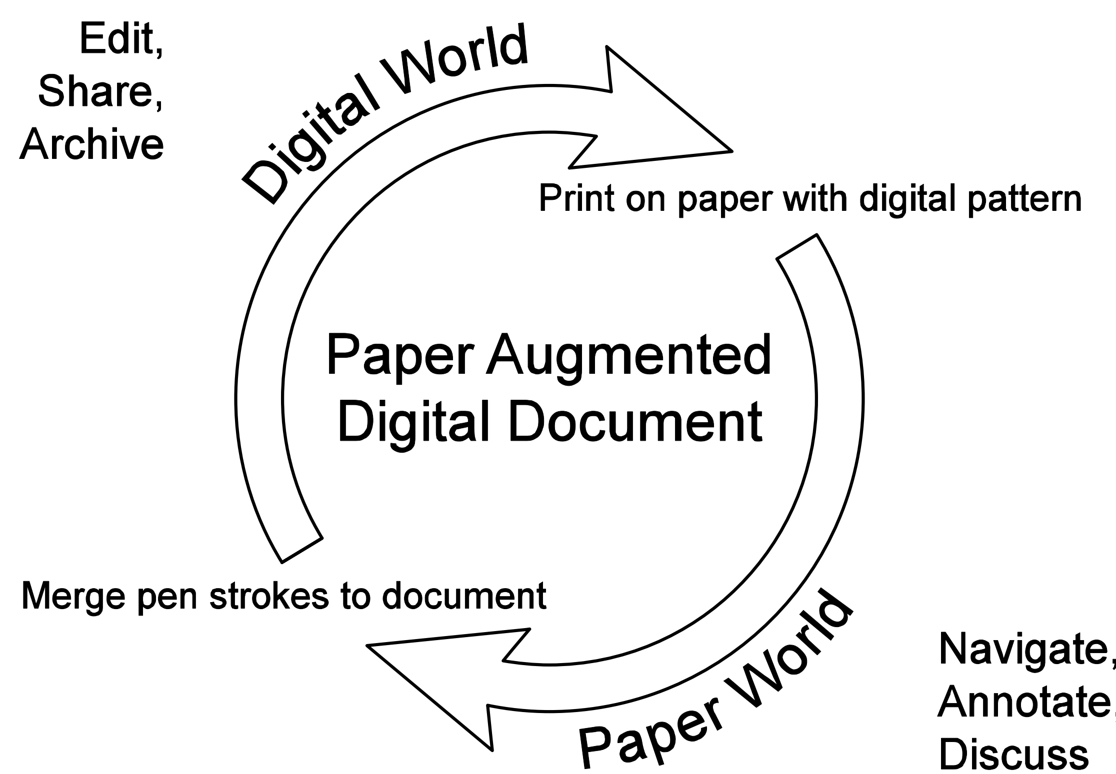
Why do you print on paper?

- Method: semi-structured interviews
  - batch printing
  - repetitive printouts
  - short life-cycle printouts
- Findings:
  - deciding on what to read
  - comparing data
  - annotating and finding errors (proof reading)
  - security
  - remember to act (have to read it)
  - re-finding documents
- Method: logging study + critical incident questionnaire (5 weeks, 9 participants)
  - 44% future annotation, 7% reading, 12% comparison, 6% sort, 5% preview, access 1%, 25% to go somewhere else.

Literature:
Wagner and Mackay “Exploring Sustainable Design with Reusable Paper” CHI’10

Paper Augmented Digital Documents

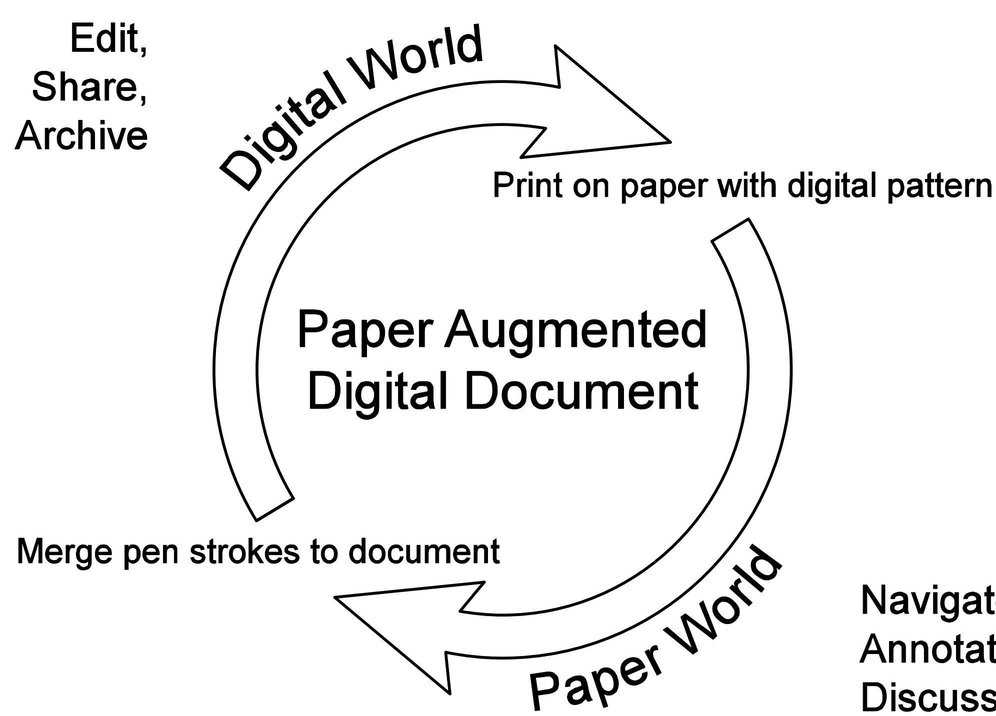




Literature:
François Guimbretière “Paper Augmented Digital Documents.” CHI’03

3D printing trends

- reduced costs: currently $1,500.00
- increased speed: currently too slow
- increased possible complexity of objects
- How could such a cycle of physical print-outs look like in the future?



Let’s watch a clip

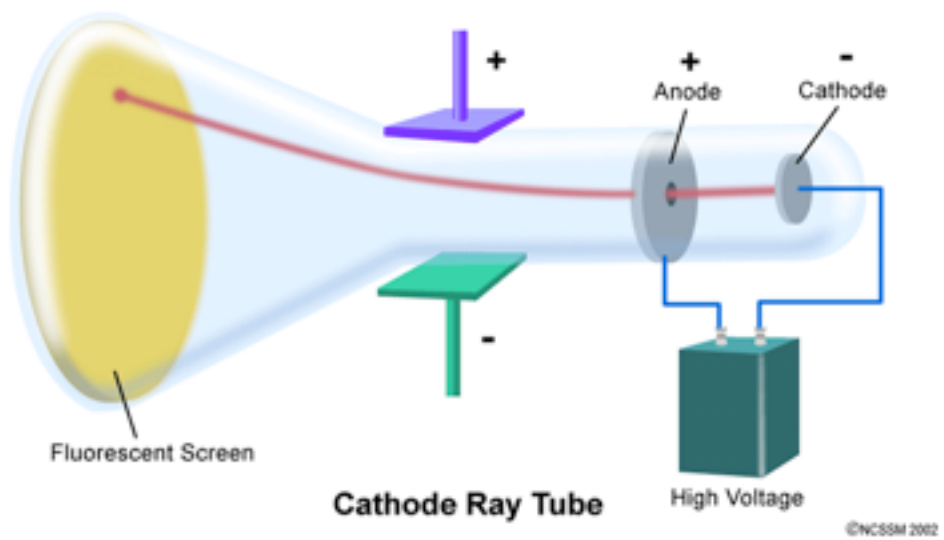
http://future.arte.tv/de/thema/3D-Druck

Visions using 3D printing

- personalized food production
- print object at home, precise
- different materials
  - wood, sand, metal
  - intelligent materials, living cell
- what's your vision?

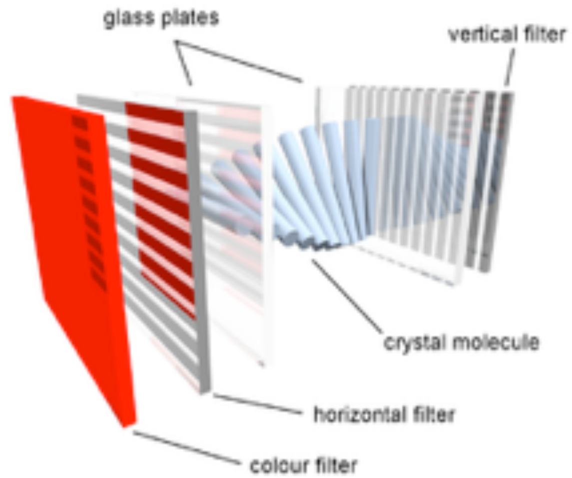
Cathode Ray Tube

- applied: old TVs and Monitors
- elements: electron gun, deflection system, fluorescent screen
- idea:
- '+': wide viewing angle, great range of colors, lower manufacturing costs
- '-': heavy, power consuming



http://www.dlt.ncssm.edu/tiger/diagrams/structure/CRT-Plates640.gif

TFT-LCD

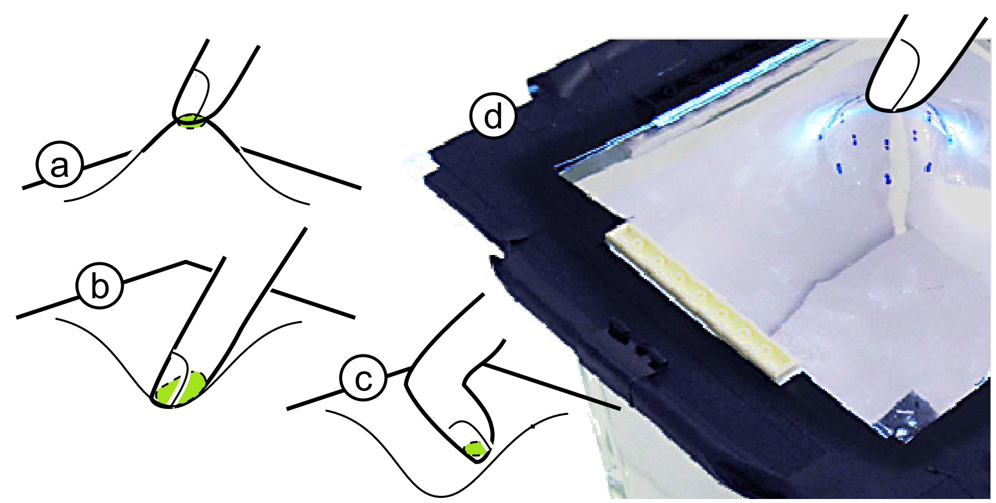


http://bucarotechelp.com/computers/anatomy/images/subpixel.png

- applied: flat screens, TV
- elements: backlight, diffusion system, shutter system
  - liquid crystals and thin-film transistors
- idea: control the molecular structure to control the passing through light.
- ‘+’: no phosphor, no “image burn-in”, wide range of screen sizes (than CRT and plasma)
- ‘-’: limited viewing angle, improved image quality from original LCD to TFT due to active-matrix addressing.

Curved Displays

http://fireuser.com/images/uploads/ScalableDesktop_-_trade_station.preview_.jpg

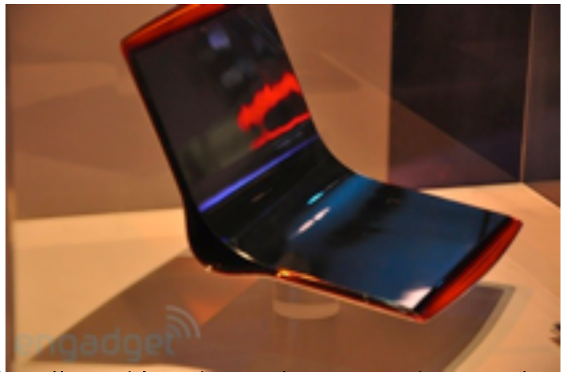


Literature:
Roudaut et al. “Touch Input on Curved Surfaces” CHI’11

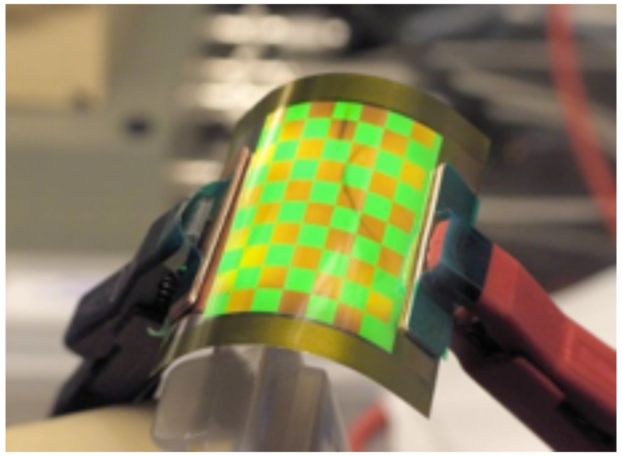
Literature:
Wimmer et al. “Curve: Revisiting the Digital Desk” CHI’10

OLED - organic light-emitting diode

- applied: PDAs, photo-camera, phones
- elements: two electrodes (one of them transparent), layer of OLED-material
- idea:
- '+': thin construction allows fabrication of flexible displays on e.g. plastic foil, no backlight, higher contrast ratio
- '-': not all colors shine with same efficiency, on-going research on optimum OLED-materials

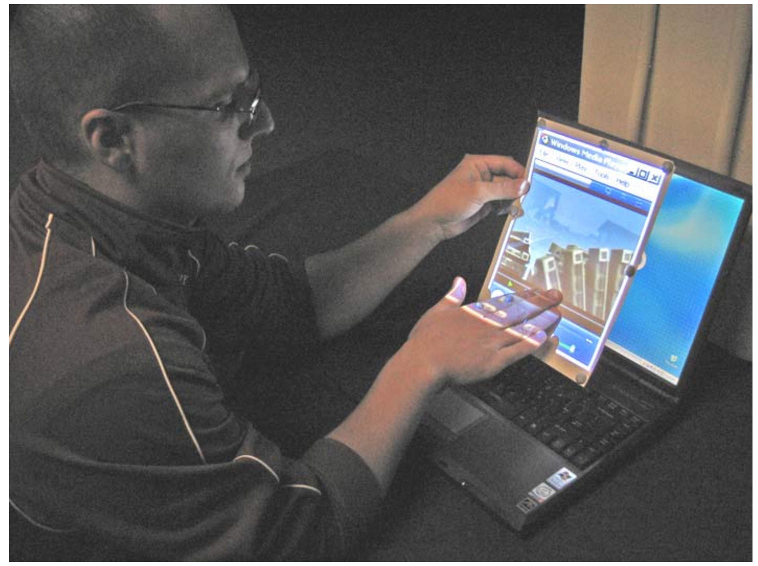


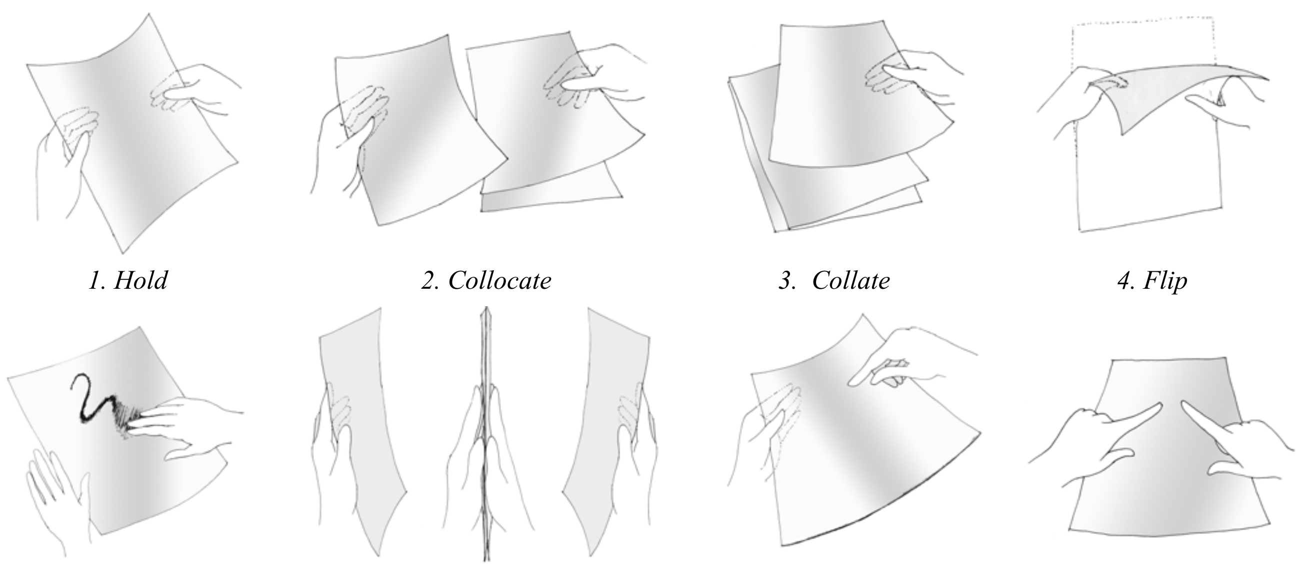
http://www.blogcdn.com/www.engadget.com/media/2009/01/sony-oled-top002.jpg

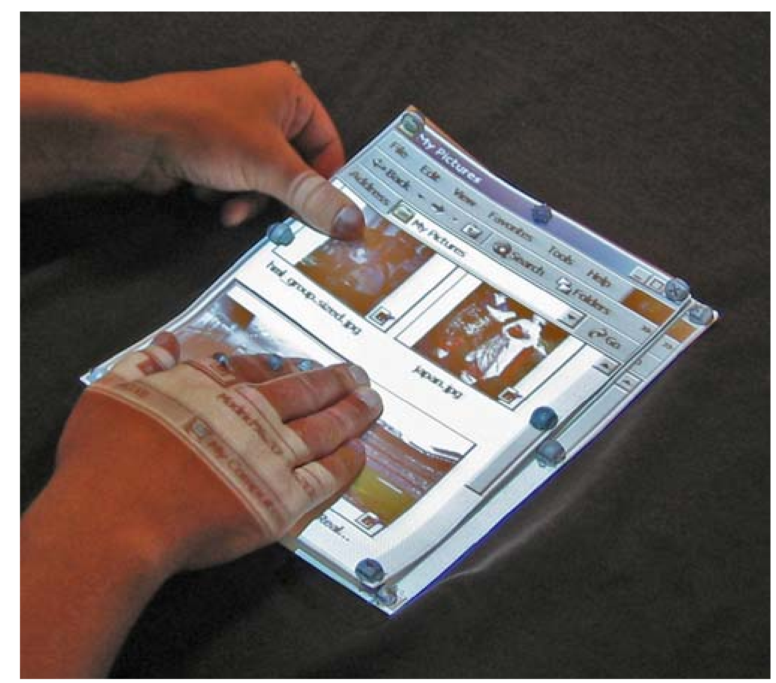


http://www.igm.uni-stuttgart.de/forschung/arbeitsgebiete/oled/index.en.html

Visions with flexible screens



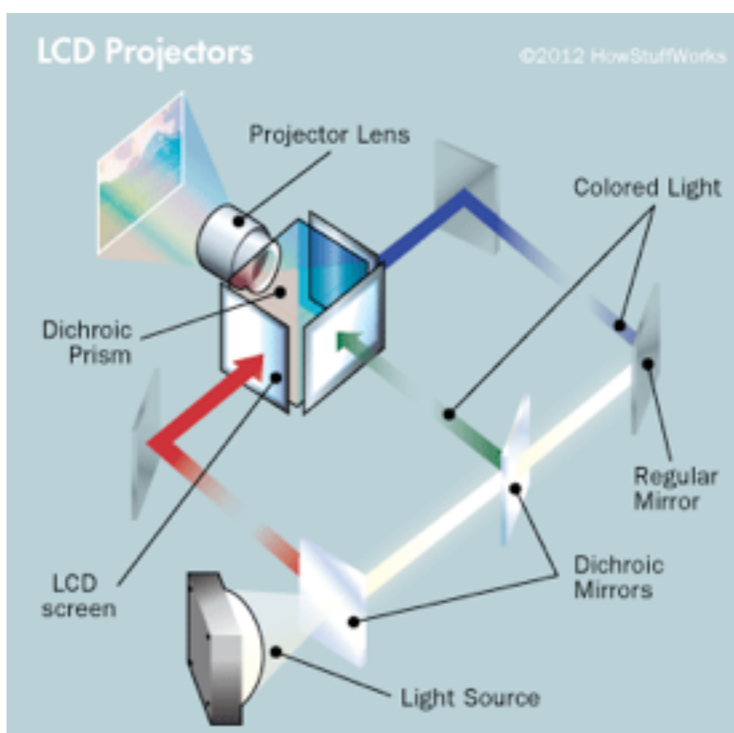


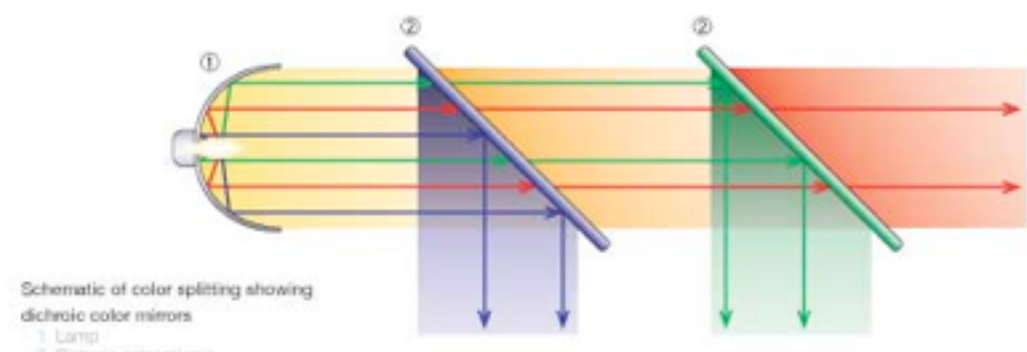


Literature:
Holman et al. “PaperWindows: Interaction Techniques for Digital Paper” CHI’05

LCD projector

- applied: projectors (home, presentation)
- elements: dichroic mirrors, dichroic prism, lcd screens
- idea:
- ‘+’: no wearing out effect.
- ‘-’: high maintenance effort (dust, smudging)

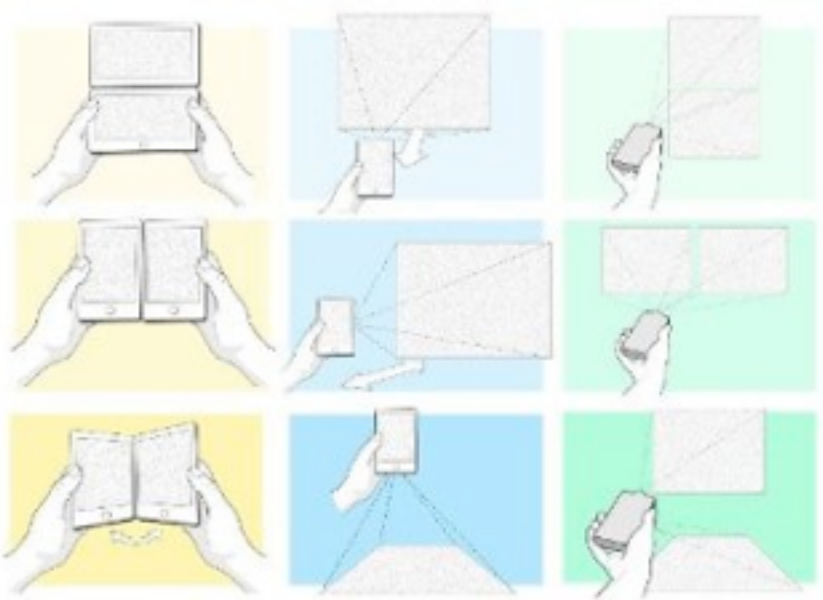


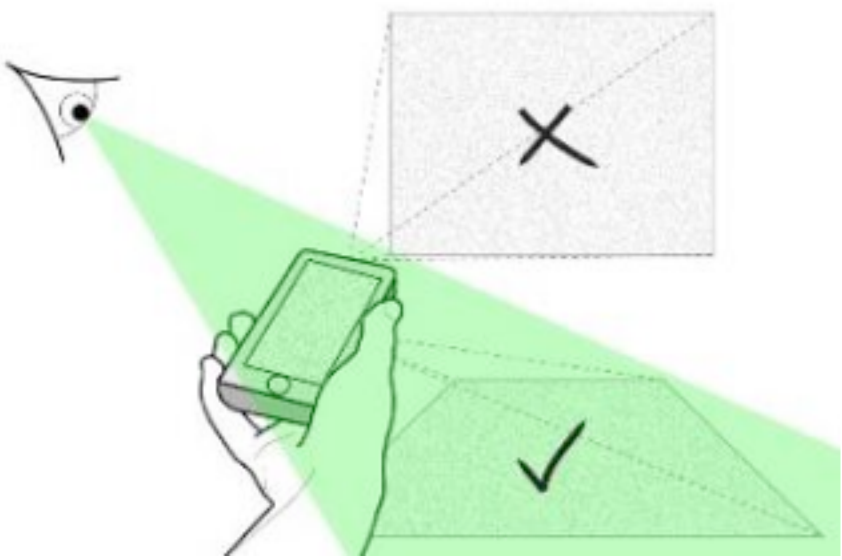


http://www.pixelteq.com/product/dichroic-mirrors/

Visions with projectors

- pico-projectors in mobile phones
- dynamic screen setup
- split the "interface"



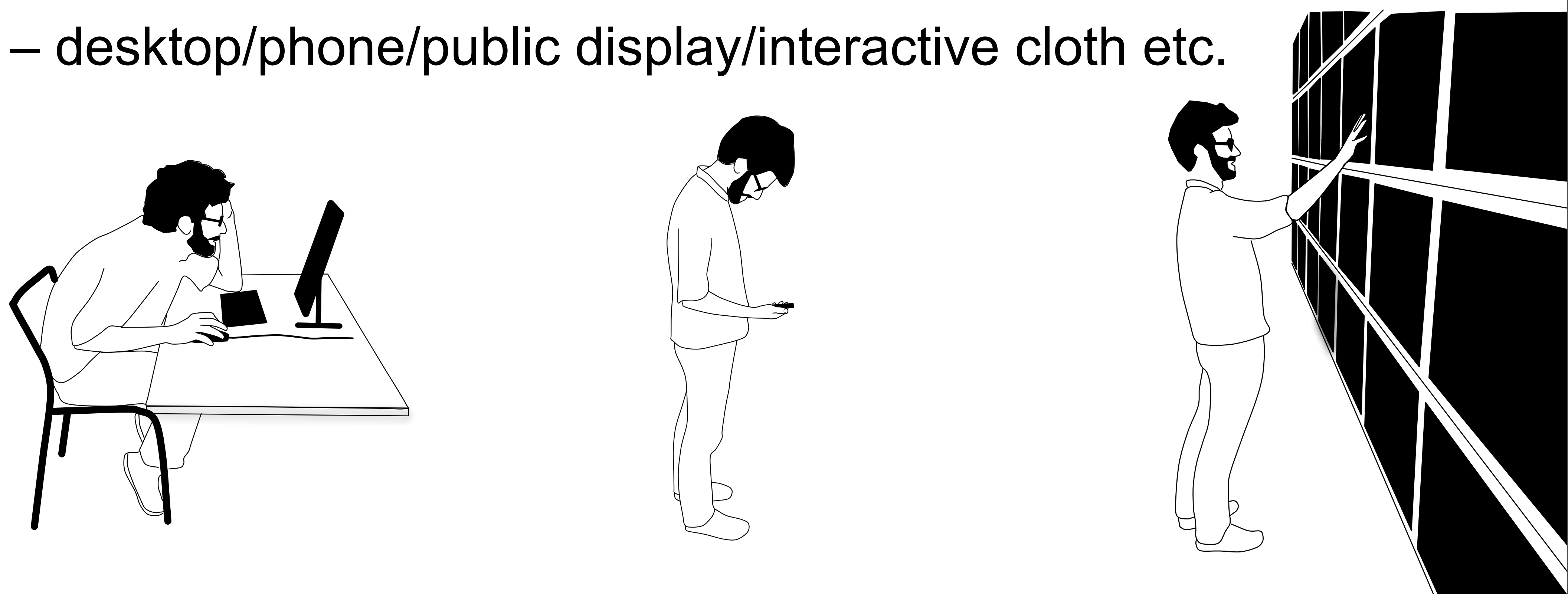


Literature:

Cauchard J.R., (2011) Visual separation in mobile multi-display environments. UIST'11

Take-away message

- from physical to digital
  - understand cognitive, emotional needs of using paper
  - new technology should replace those needs otherwise people will continue using their traditional way.
- from digital to physical
  - what are the needs (look for potentials)? join our research!
- design for transition
  - make working in “trial and error“- fashion possible.
  - desktop/phone/public display/interactive cloth etc.



For your next assignment

- video prototypes: communicate, act out your ideas for interactive systems.
- examples:
  - good example: http://users-cs.au.dk/clemens/BerkeleyMultiSurface2012/Prototypes/sharespose.mov
  - bad example: http://users-cs.au.dk/clemens/BerkeleyMultiSurface2012/Prototypes/physicalartifacts.mov

Literature:

Mackay, W. (2002), Video to Support Interaction Design, DVD, ISBN 1-58113-516-5, ACM, New York.
http://www.cs.ubc.ca/~cs544/video/Mackay-using-video-usletter.pdf