

Usable Digital World

Human-Computer Interaction

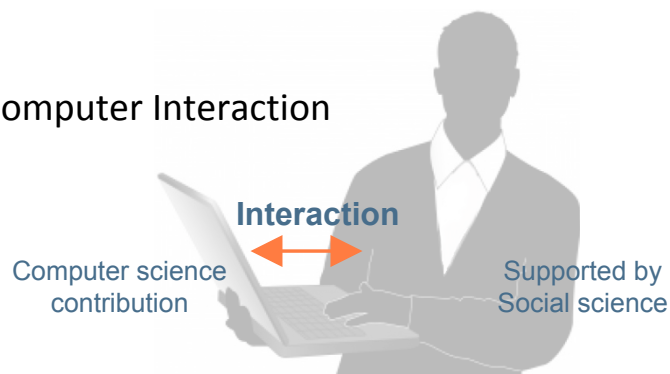
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EHCI team - Engineering for Human-Computer Interaction



Scientific domain

- Human-Computer Interaction



- Designing, developing and evaluating interaction techniques
- Development of conceptual and technical tools based on HCI principles: Utility, Usability, Context

Usable Digital World: Context

- HCI in the context of Digital and Human Ecosystems

– a seamless environment of computing

The Computer for the 21st Century
1991 – M. Weiser



Usable Digital World: Context

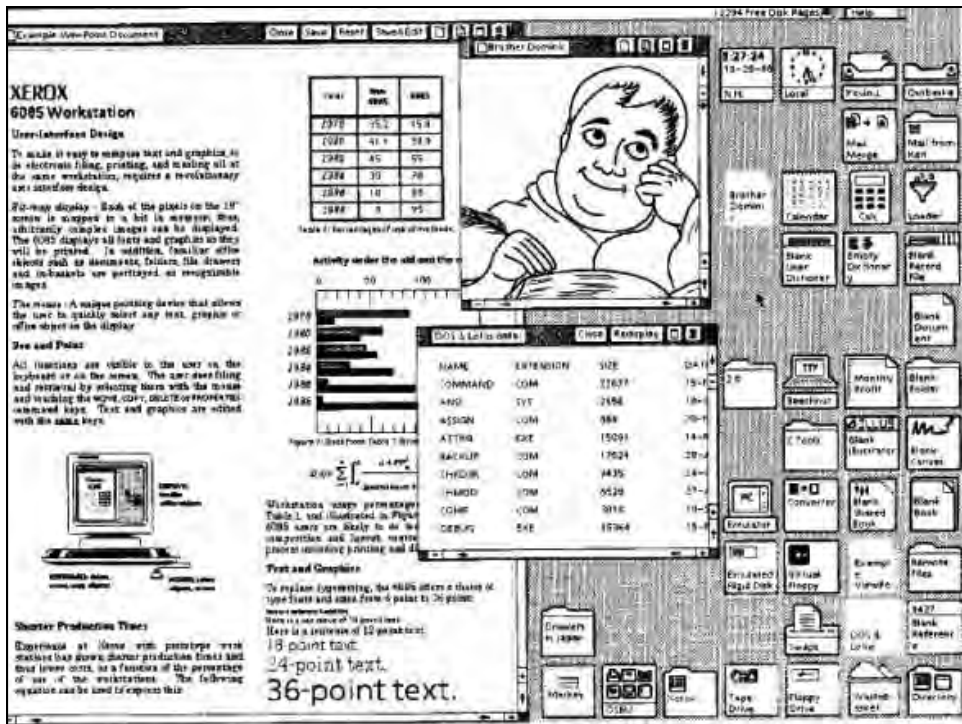
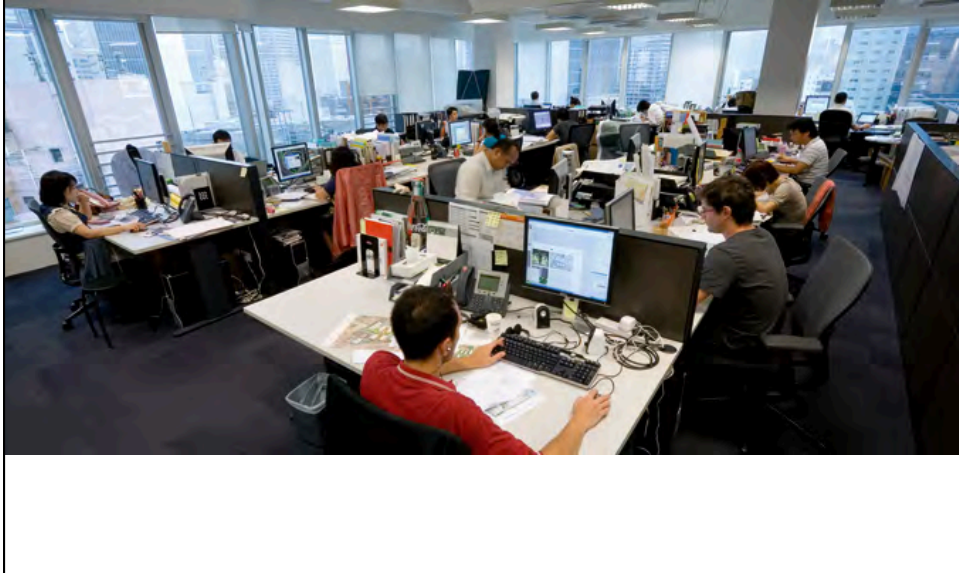
Invisible technology

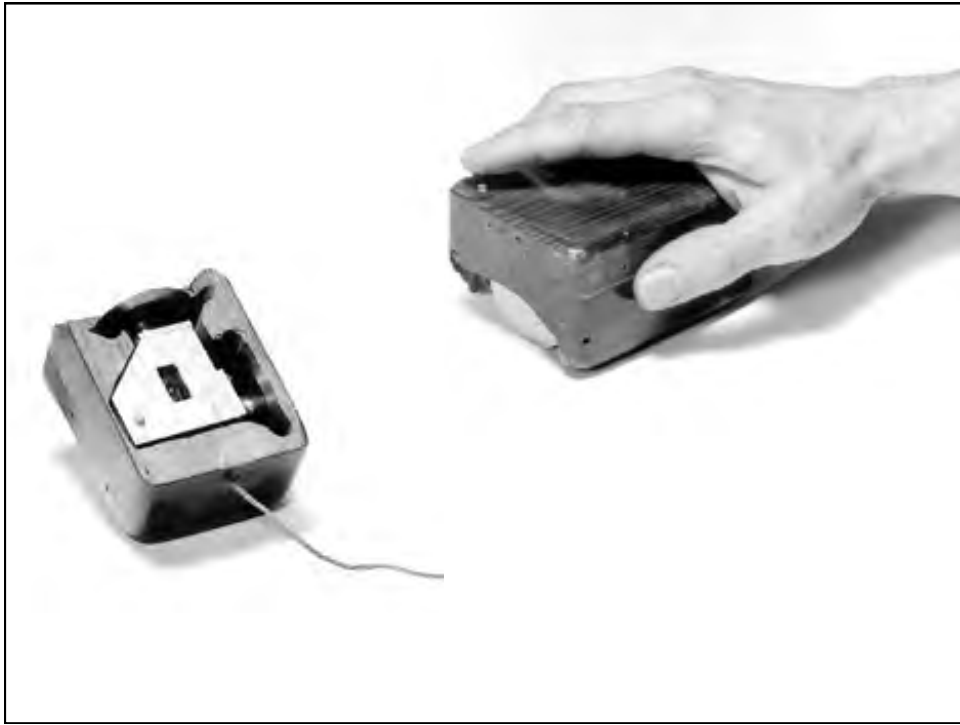
Technology available at any place

Symbiosis of the real and digital worlds



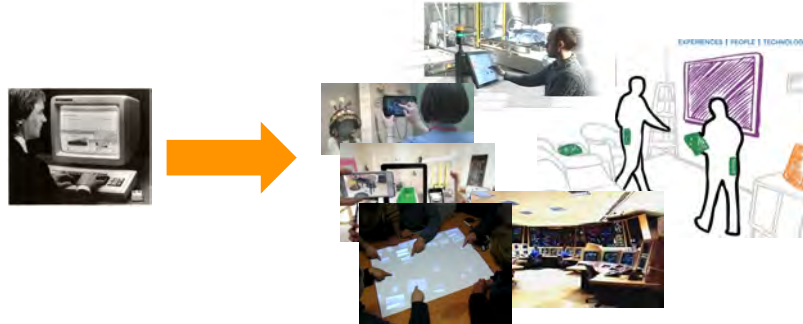
From WIMP - Windows Icons Menu Pointer





Usable Digital World: Context

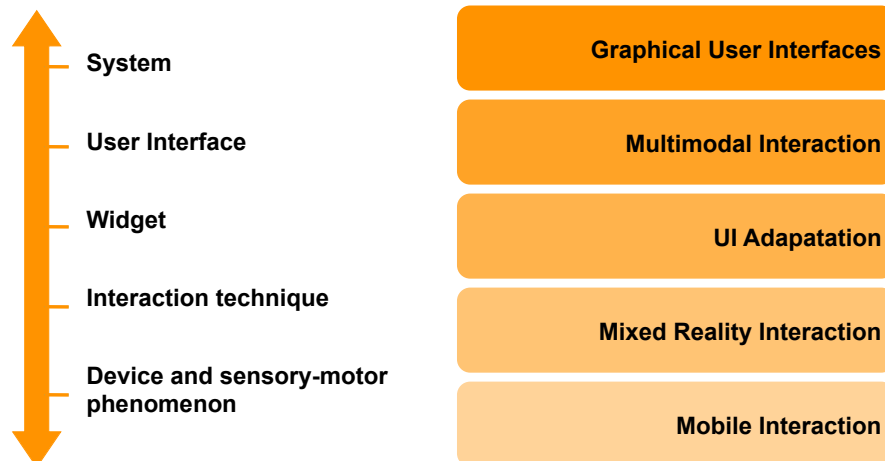
A seamless environment of computing



The Xerox Star has reached its limits
<http://www.digibarn.com/>

Computers are everywhere
 HCI is « out of the box »

Research themes



Ubiquitous environments: Distant pointing



Distant pointing

- Physical targets

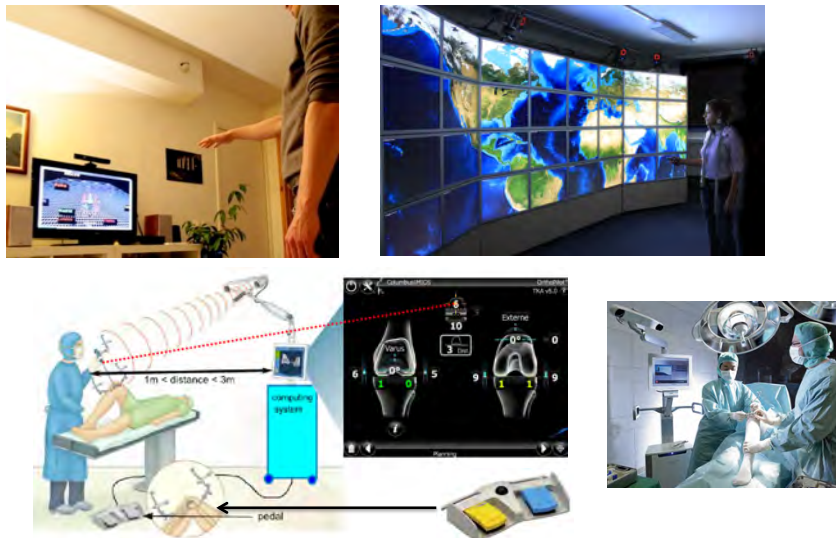


Distant pointing

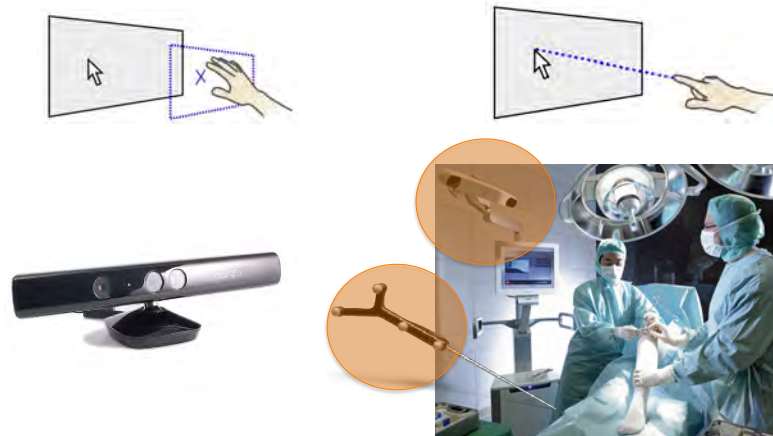
- Digital targets



Distant pointing: digital targets



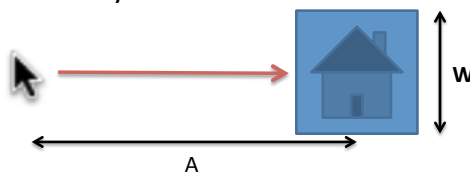
Pointing technologies



Pointing gestures

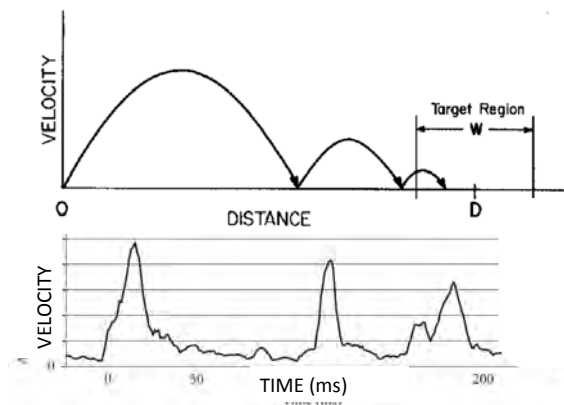
- Fitts' Law: $MT = a + b \log_2 \left(\frac{A}{W} + 1 \right) \rightarrow ID$

Movement Time, Amplitude, Target Width, Index of Difficulty



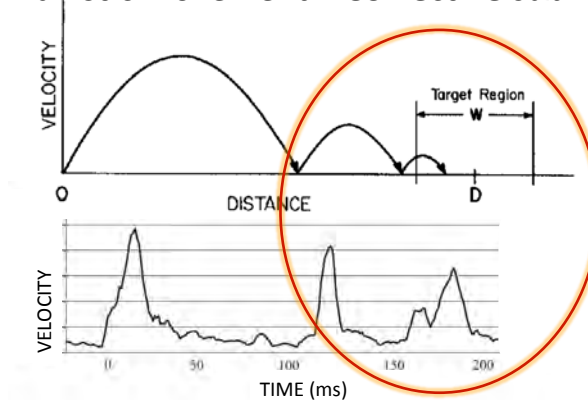
Pointing gestures

- Initial Impulse Model [Meyers, 1988]:
 - **Ballistic** movement + **Corrective** sub-movements



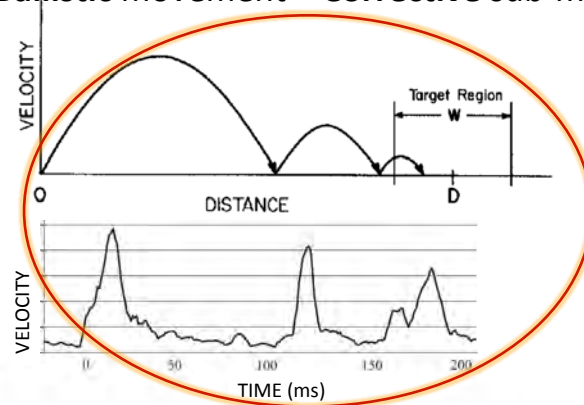
Pointing gestures

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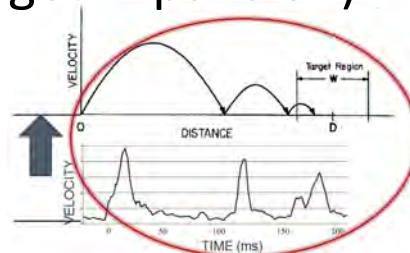
Pointing gestures

- Initial Impulse Model [Meyers, 1988]:
 - **Ballistic** movement + **Corrective** sub-movements



VTE (Voronoi Target Expansion)

- Target expansion
 - Static global target augmentation

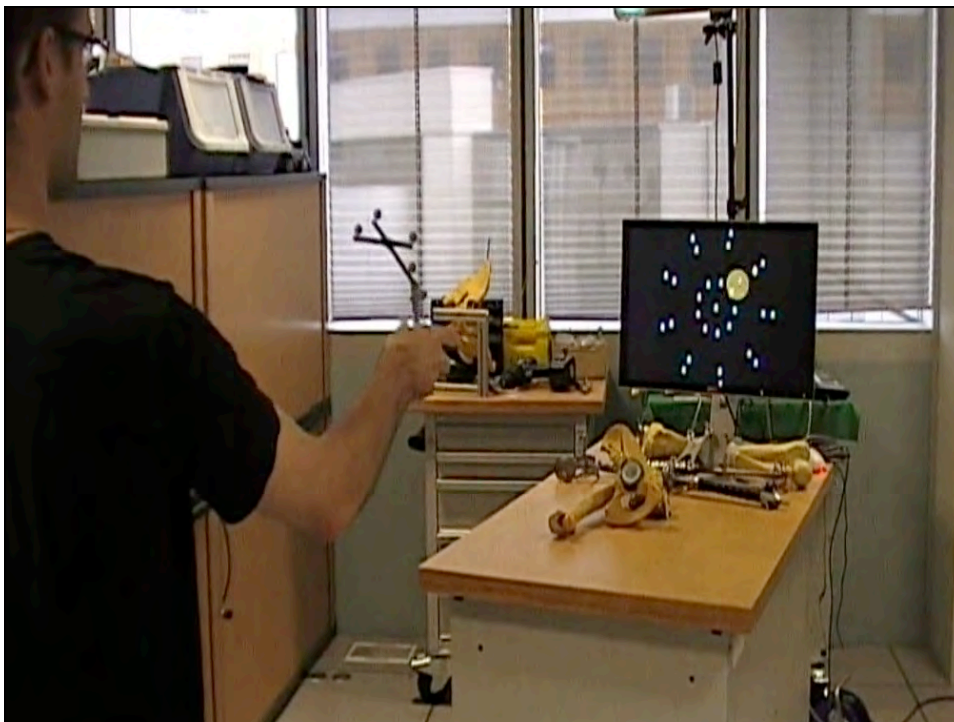


- « Closest target » principle
 - Voronoi tessellation

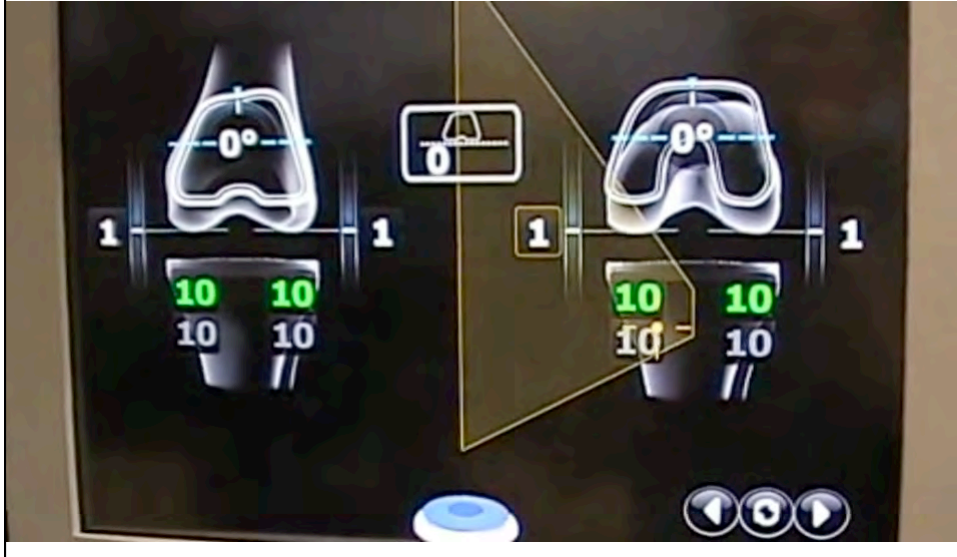


VTE Rationale

- Novice users
 - 10 pointings / surgery
- Cognitive simplicity
 - Simple forms
 - Simple cursor
 - Visual stability



Target expansion



Distant pointing: physical targets

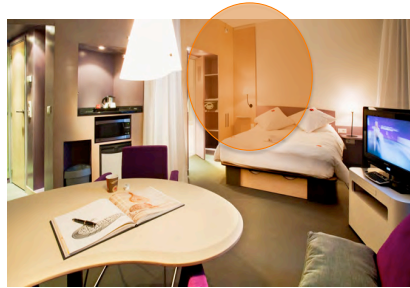


Distant pointing: physical targets

**Direct
physical
interaction**



**Handheld
AR**



Physical Object Selection: Disambiguating



Pointing Task in the Physical World

Ray-Casting is difficult to improve in the physical world

Volume-based pointing & disambiguation step



Balancing Focus And Performance



Physical World

Digital Representation

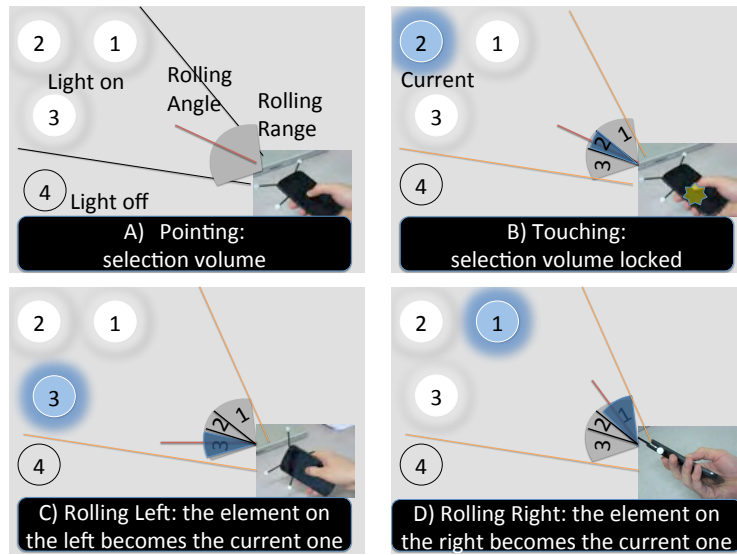
→ Design of focus-maintaining
 [?] Disambiguation Techniques



[Ailisto, 2006]
 [Välkkynen, 2006]

Physical Pointing Roll (**P2Roll**)
 Physical Pointing Slide (**P2Slide**)

P2Roll



P2Roll



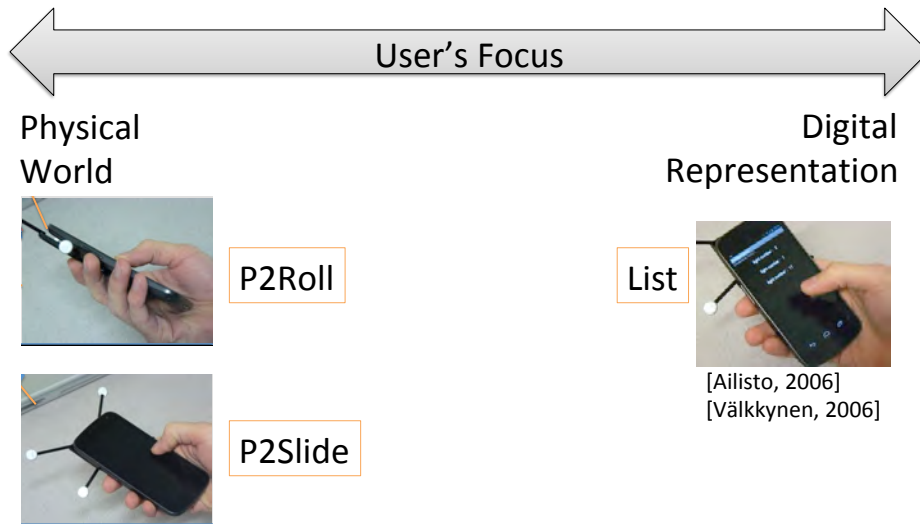
P2Slide



Baseline: List

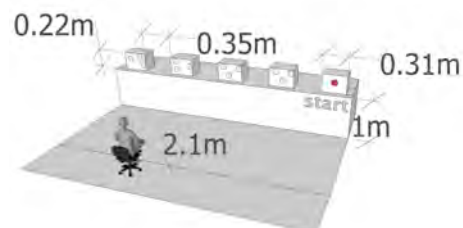


Design Rationale: User's Focus

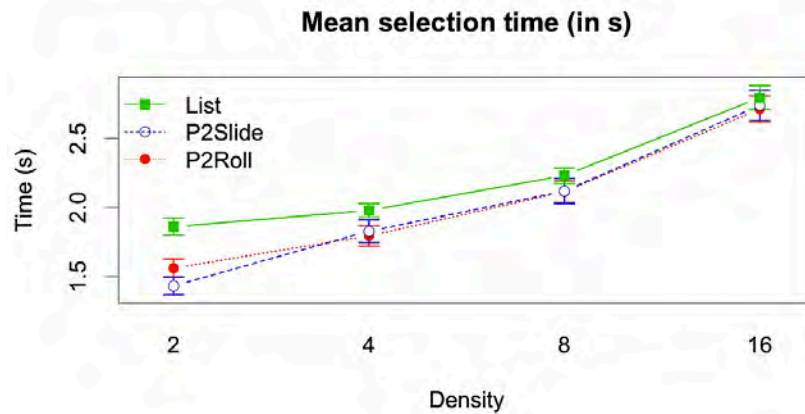


Experiment: Targets

Densities:
2, 4, 8 and 16 targets



Results: Completion Time



Distant pointing: physical targets

Direct
physical
interaction



Handheld
AR



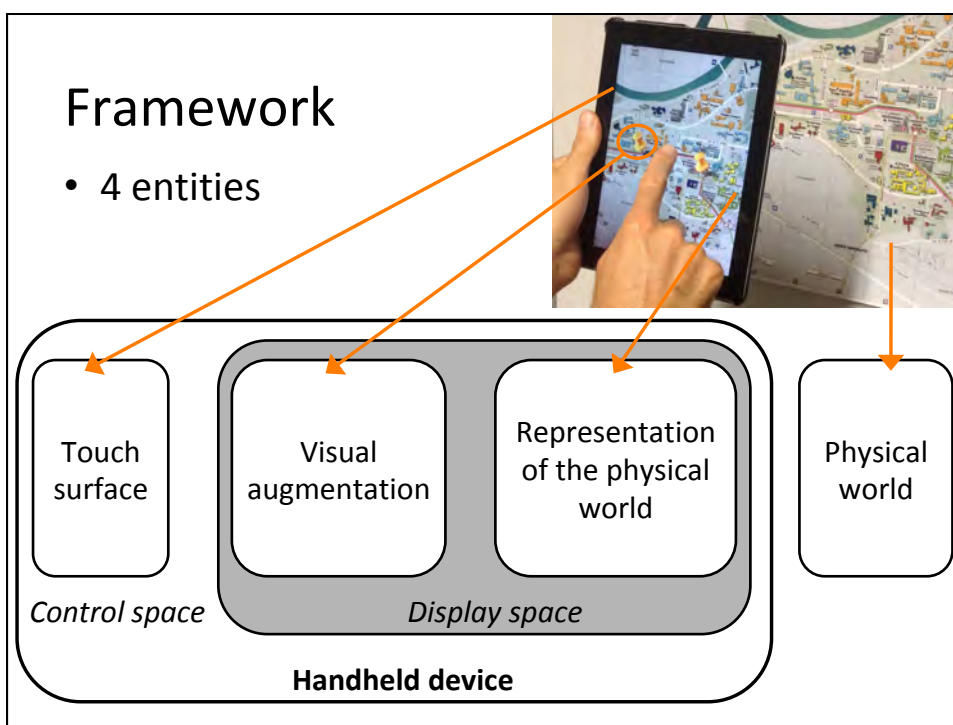
AR: Pointing at physical targets

- Specific to AR:
 - ‘Real’ AND ‘Virtual’
 - Spatiotemporal relationship between the physical world and digital content
- How to relax the **spatial constraint** while keeping physical/digital colocation?



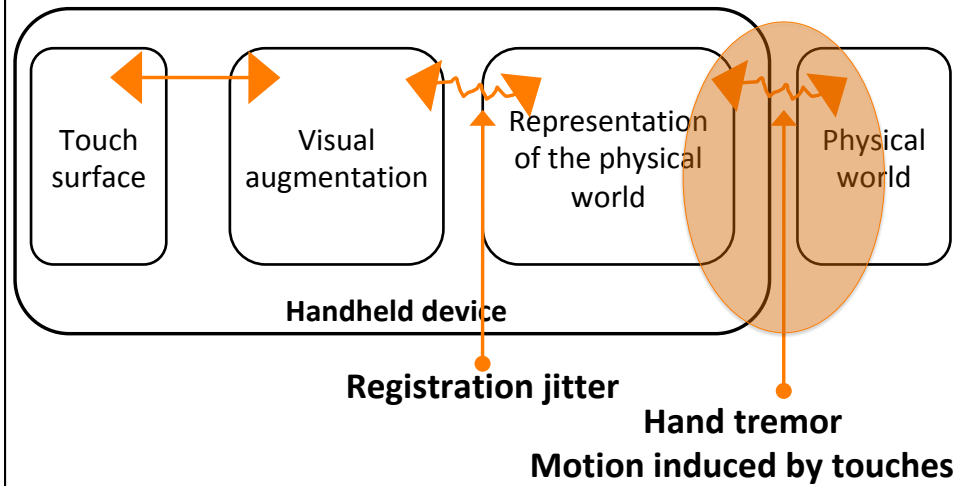
Framework

- 4 entities



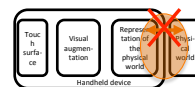
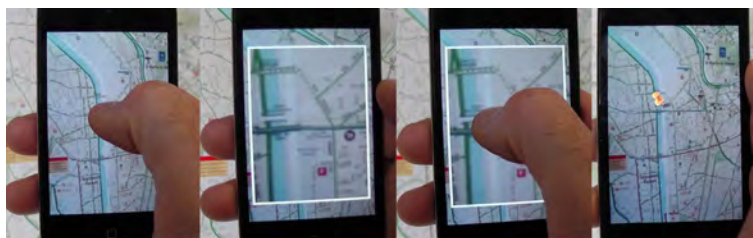
Framework

- 4 entities **linked by spatial relationships**

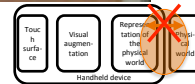
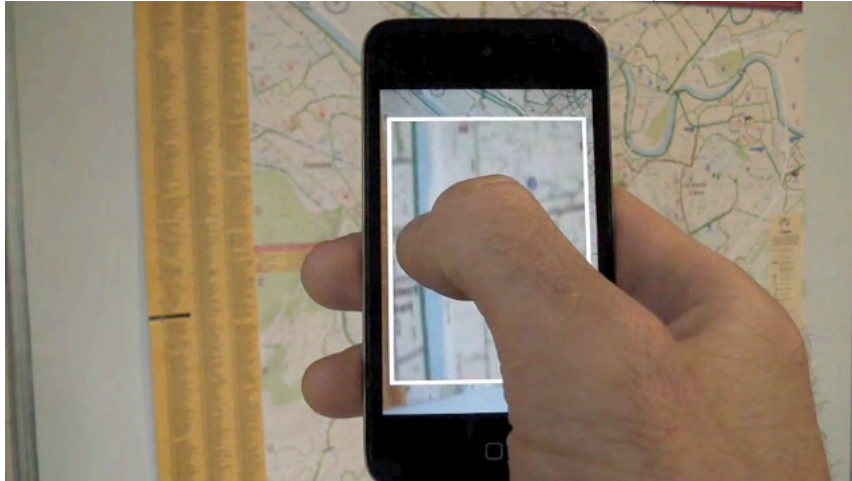


Spatial mapping between the physical world and its representation

- Adapt TapTap [Roudaut 08] to AR
 - Explicit and transient freeze rather than sustained
 - 2 views: one with freeze, the other with live video

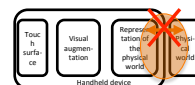


Spatial mapping between the physical world and its representation

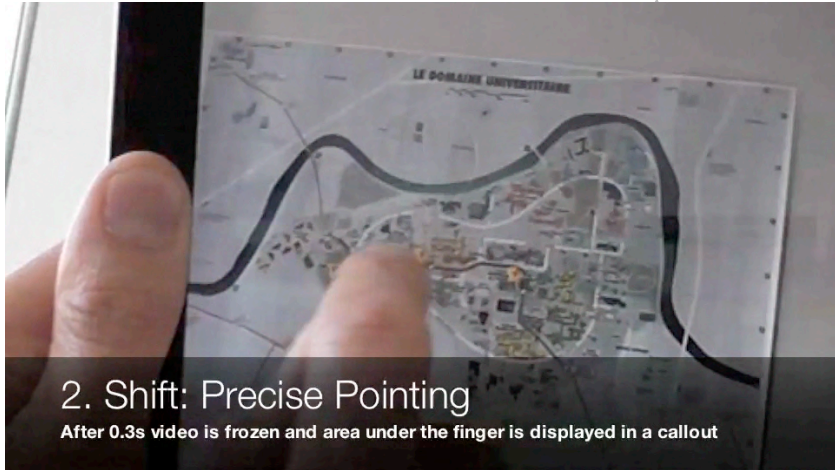


Spatial mapping between the physical world and its representation

- Adapt Shift [Vogel 2007] with freeze-frame
 - Shift's callout and cursor overcome the 'fat finger' problem
 - Freeze-frame avoids viewpoint instability
 - On-demand precise quasi-mode

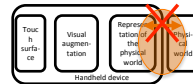


Spatial mapping between the physical world and its representation



2. Shift: Precise Pointing

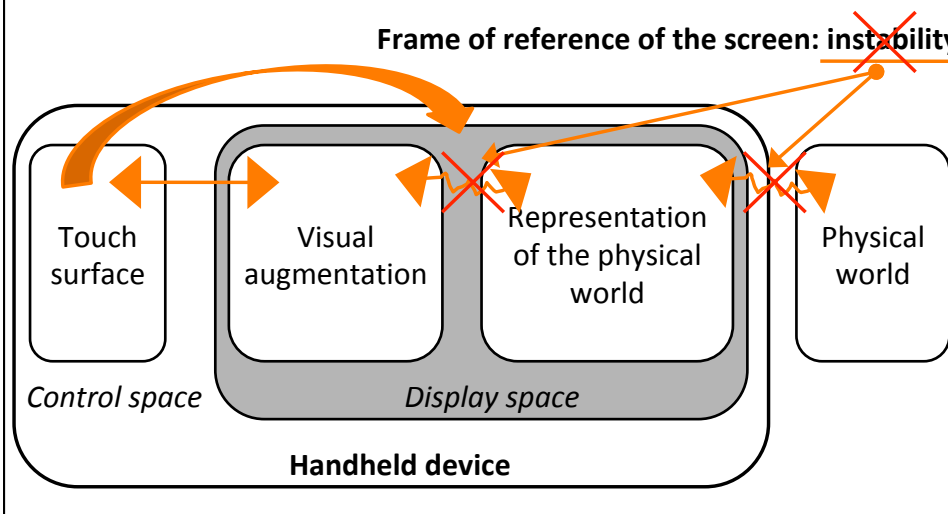
After 0.3s video is frozen and area under the finger is displayed in a callout



Framework

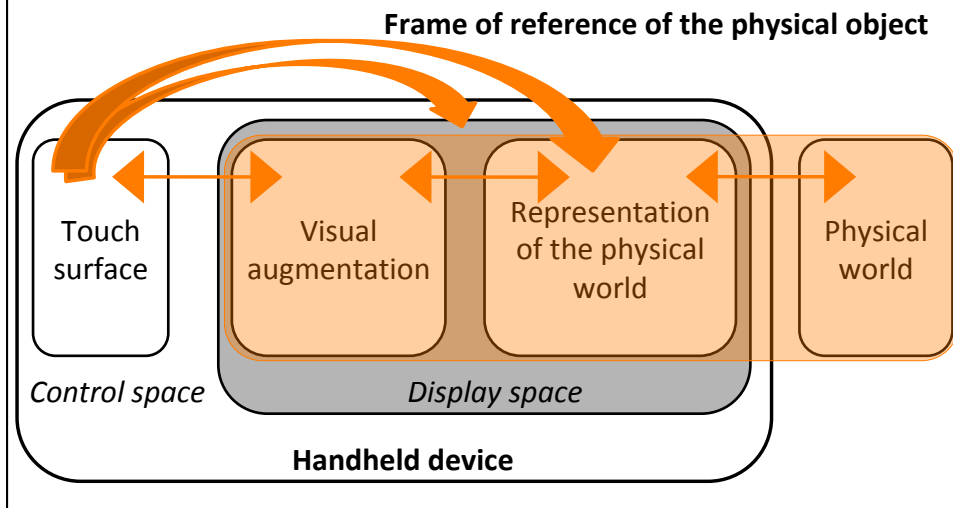
- Frames of reference for pointing

Frame of reference of the screen: ~~instability~~

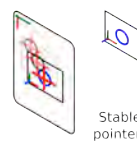
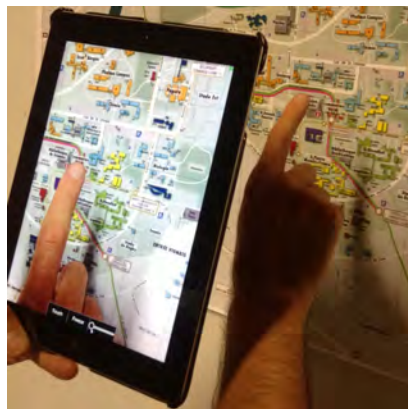


Framework

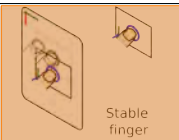
- Frames of reference for pointing



Frame of reference of the physical object



Relative Pointing



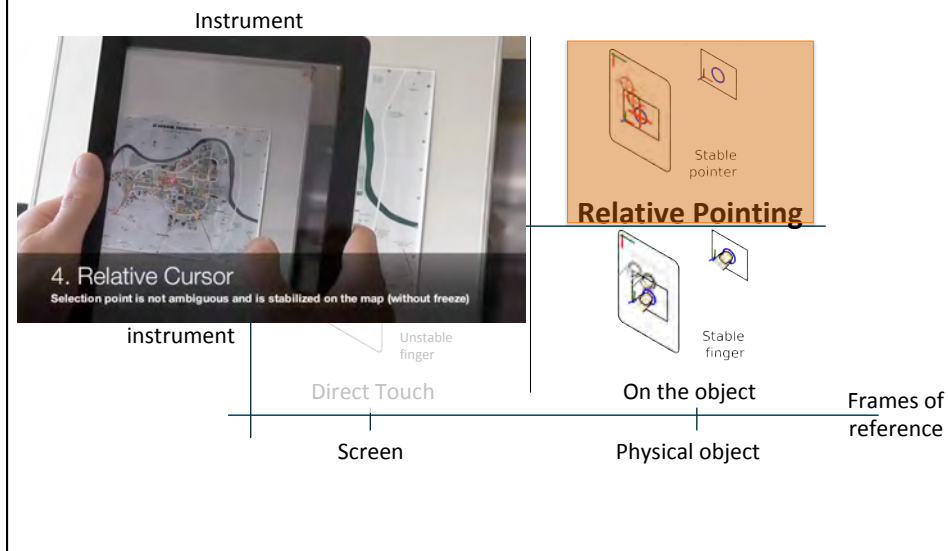
On the object

Screen

Physical object

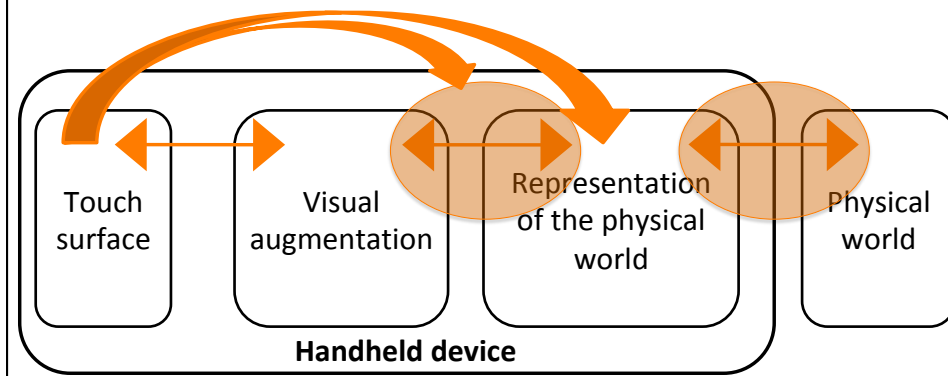
Frames of reference

Frame of reference of the physical object



Handheld AR : Pointing at physical targets

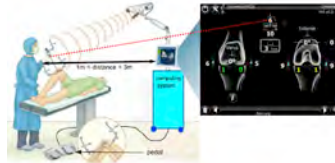
- 4 entities linked by spatial relationships
- 2 frames of reference for pointing



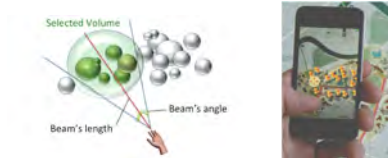
Distant pointing in ubiquitous environment

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- Distant pointing: precision



- Digital targets



- Physical targets

Conclusion: new research axis

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- Deformable / Shape-changing User Interfaces





<http://iihm.imag.fr/en/>

Thank you for your attention

Questions? Comments?