Hybrid Interaction in Unobtrusive Augmented Reality

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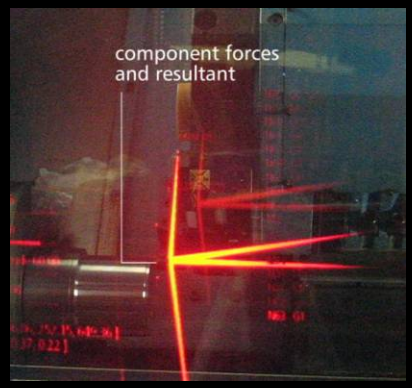
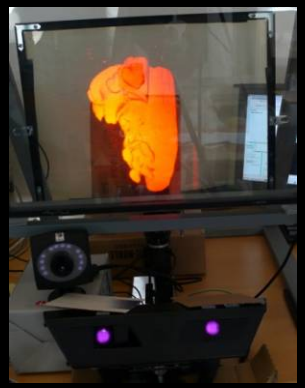
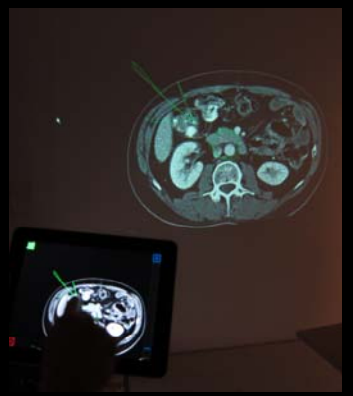


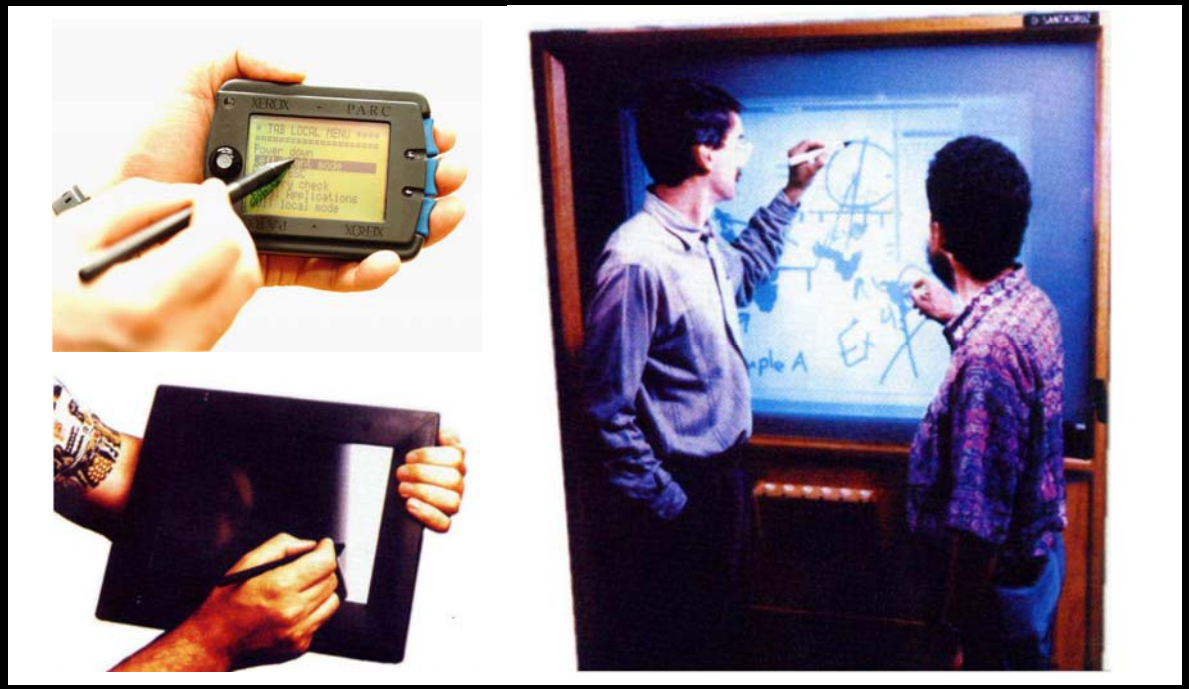





Ubiquitous computing

Weiser 1993

Ubiquitous

- Displays
- Sensing
- Connectivity

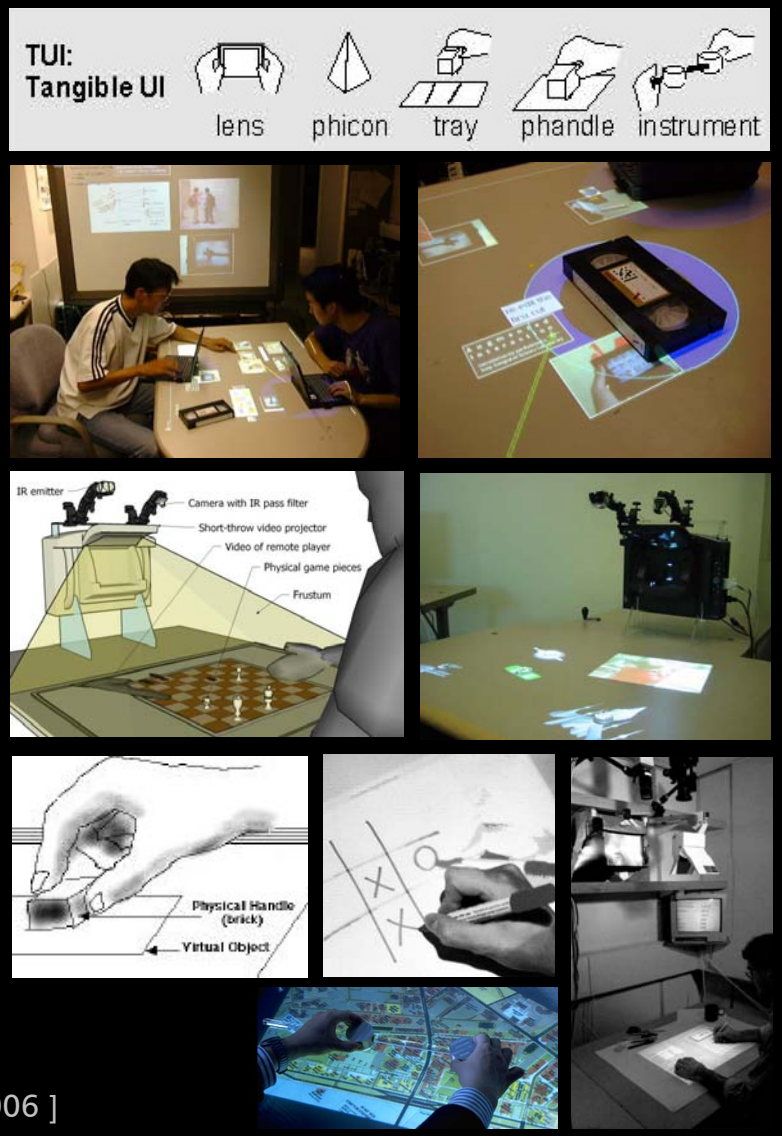


Devices

- Tabs, pads & boards

Interactive surfaces & tangible UIs

- Display 2D graphics
- Sense on & above surface
- Detect & augment objects



DigitalDesk [Wellner 1993]

Tangible Bits [Ullmer & Ishii & Buxton 1997]

Augmented Surfaces [Rekimoto & Saitoh 1999]

PlayAnywhere / PlayTogether [Wilson 2005 / Wilson & Robbins 2006]

Spatially aware displays

- Tracked display
- Context-sensitive
- Focus + context




Chameleon [Fitzmaurice 1993]
NaviCam [Rekimoto 1995]
Augmented Notebook [Mackay et al. 2002]
Focus + Context displays [Baudisch et al. 2002]
VITA [Benko et al. 2004]
Ubiquitous graphics [Sanneblad & Holmquist 2006]

Hybrid interaction in unobtrusive AR

1. Unobtrusive
2. Sensing in environment

AR, UbiComp, Mobile, Interactive Surfaces, …

Shopping window

Microsoft Surface

LightSense

Dynamic augmentations of printed media

ISMAR 2006 [Olwal]
Proc. IEEE & ACM International Symposium on Mixed & Augmented Reality

Ericsson Demo Center
Stockholm 2008

LightSense

a) Camera-based

+ Continuous tracking

+ Depth estimation

0 cm ~ 10 cm ~ 20 cm

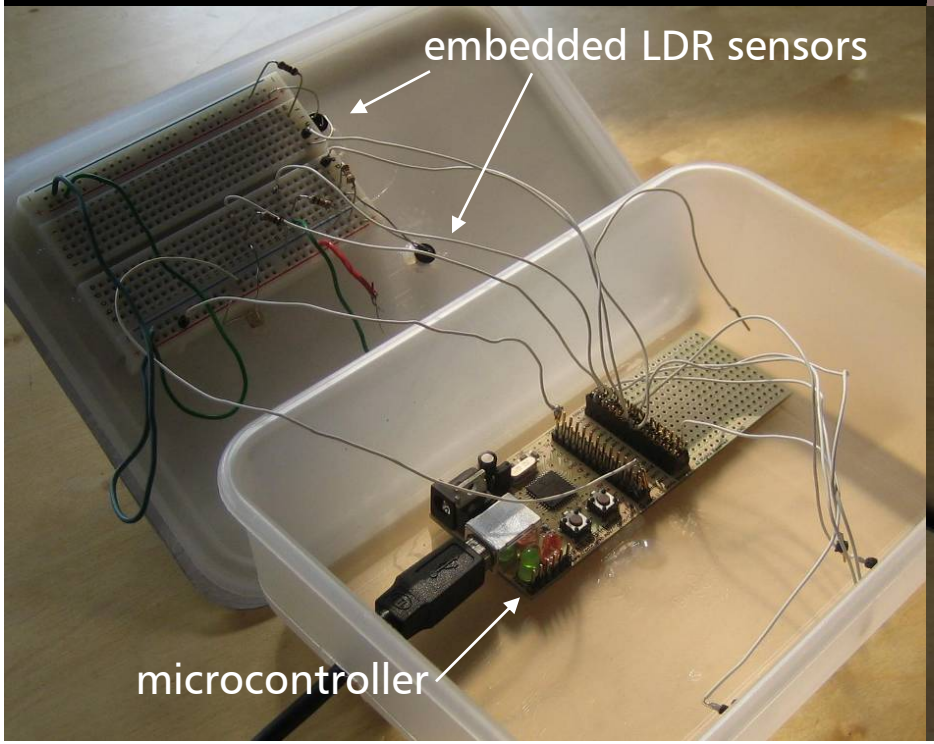
– Computer

– Large setup

LightSense

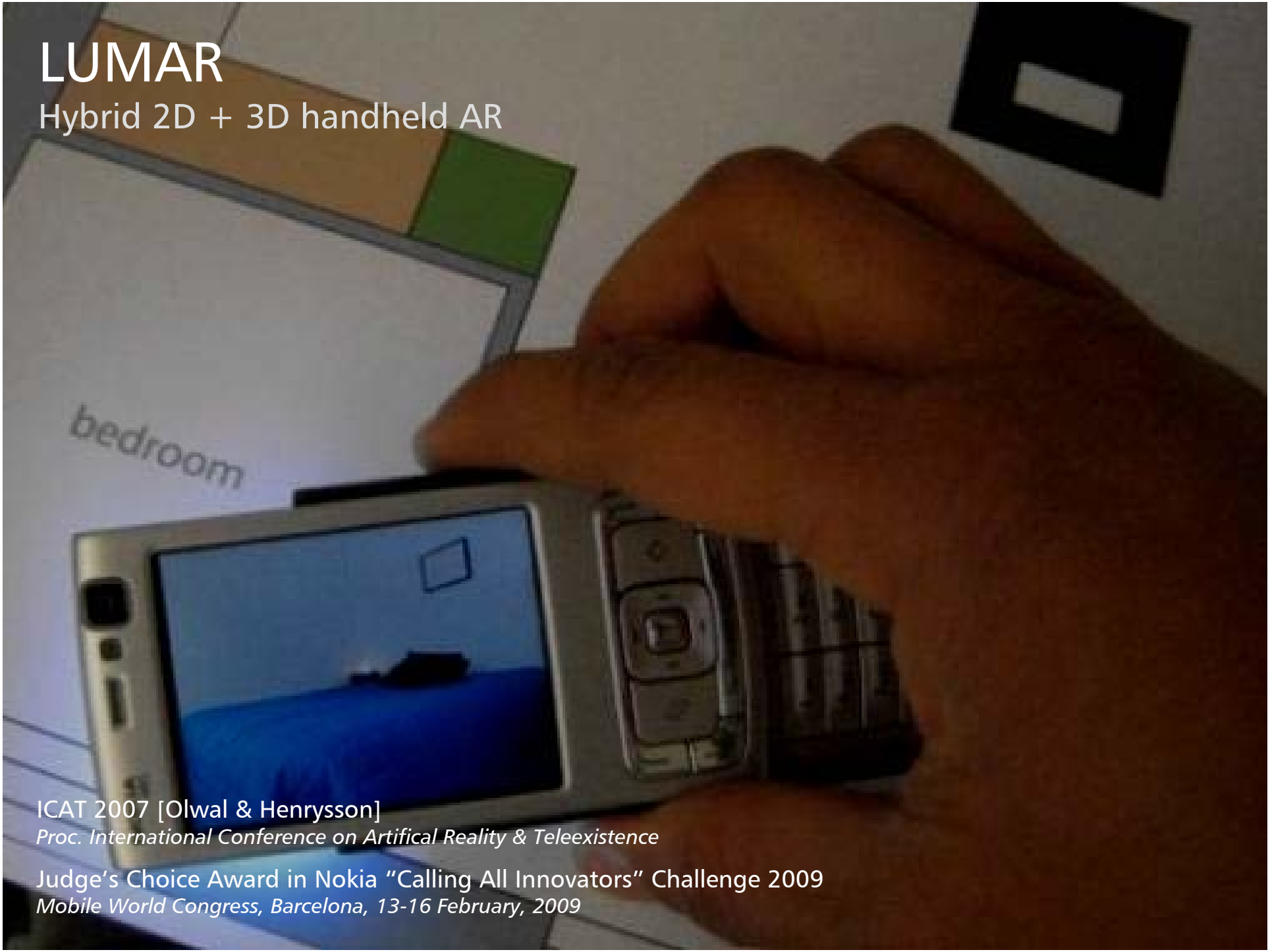
b) Photosensors

+ Thin
+ Embedded & low-cost
– Discrete
– No distance



LUMAR

Hybrid 2D + 3D handheld AR

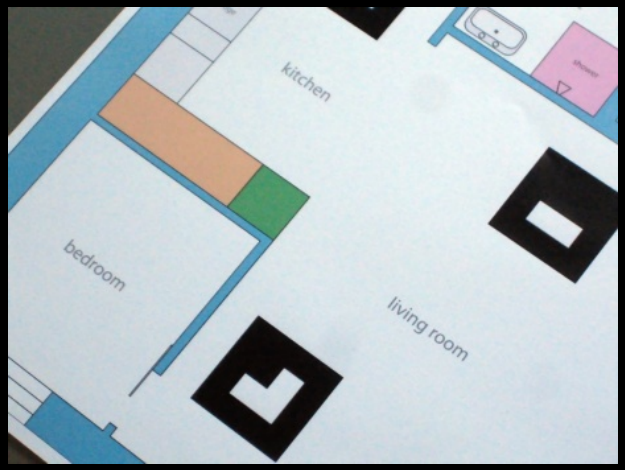


ICAT 2007 [Olwal & Henrysson]
Proc. International Conference on Artifical Reality & Teleexistence

Judge's Choice Award in Nokia "Calling All Innovators" Challenge 2009
Mobile World Congress, Barcelona, 13-16 February, 2009

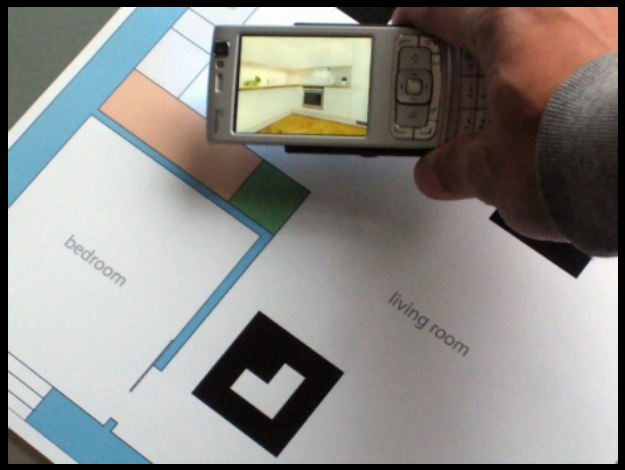
LUMAR

Hybrid 2D + 3D handheld AR



Printed media

Floor plan



2D graphics

Photographs

3D graphics

3D model

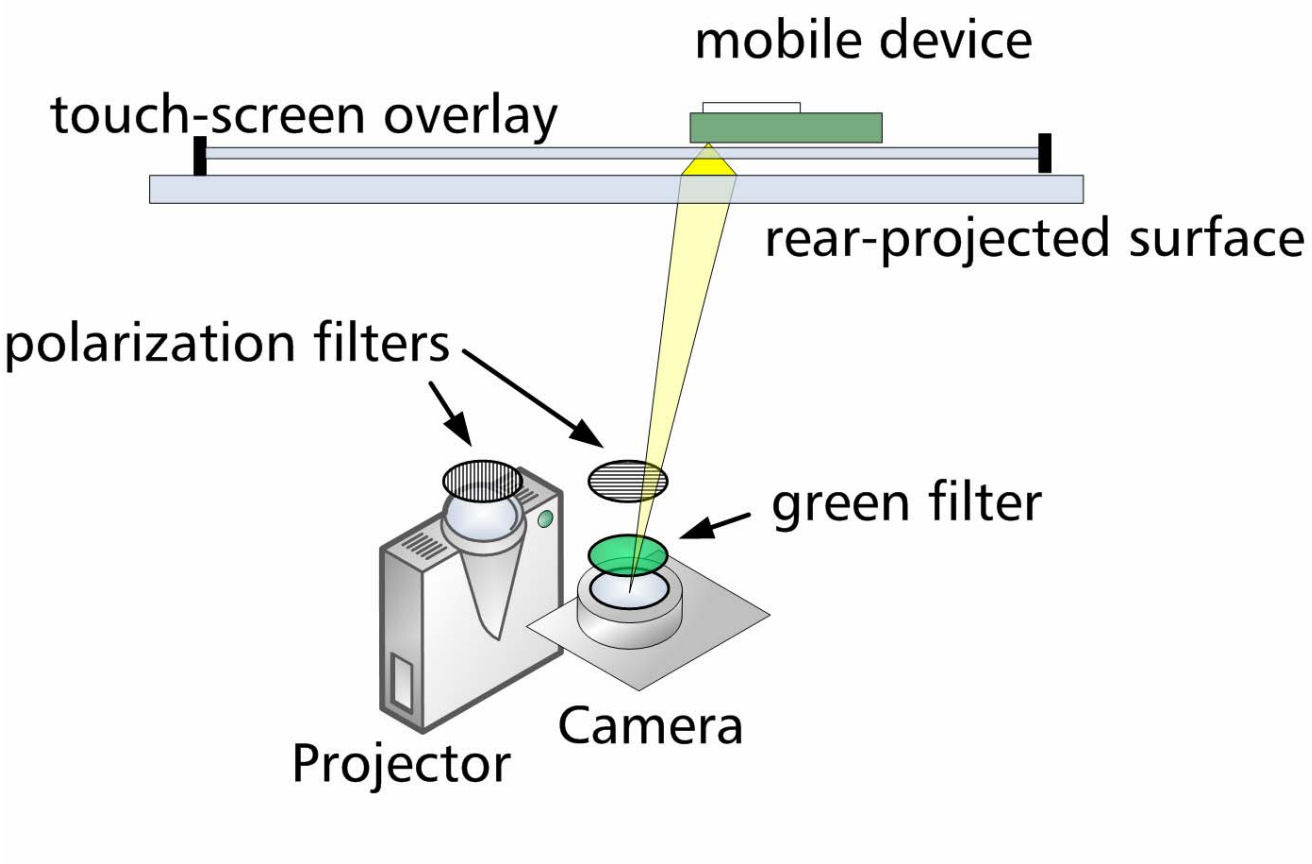
Spatially aware handhelds

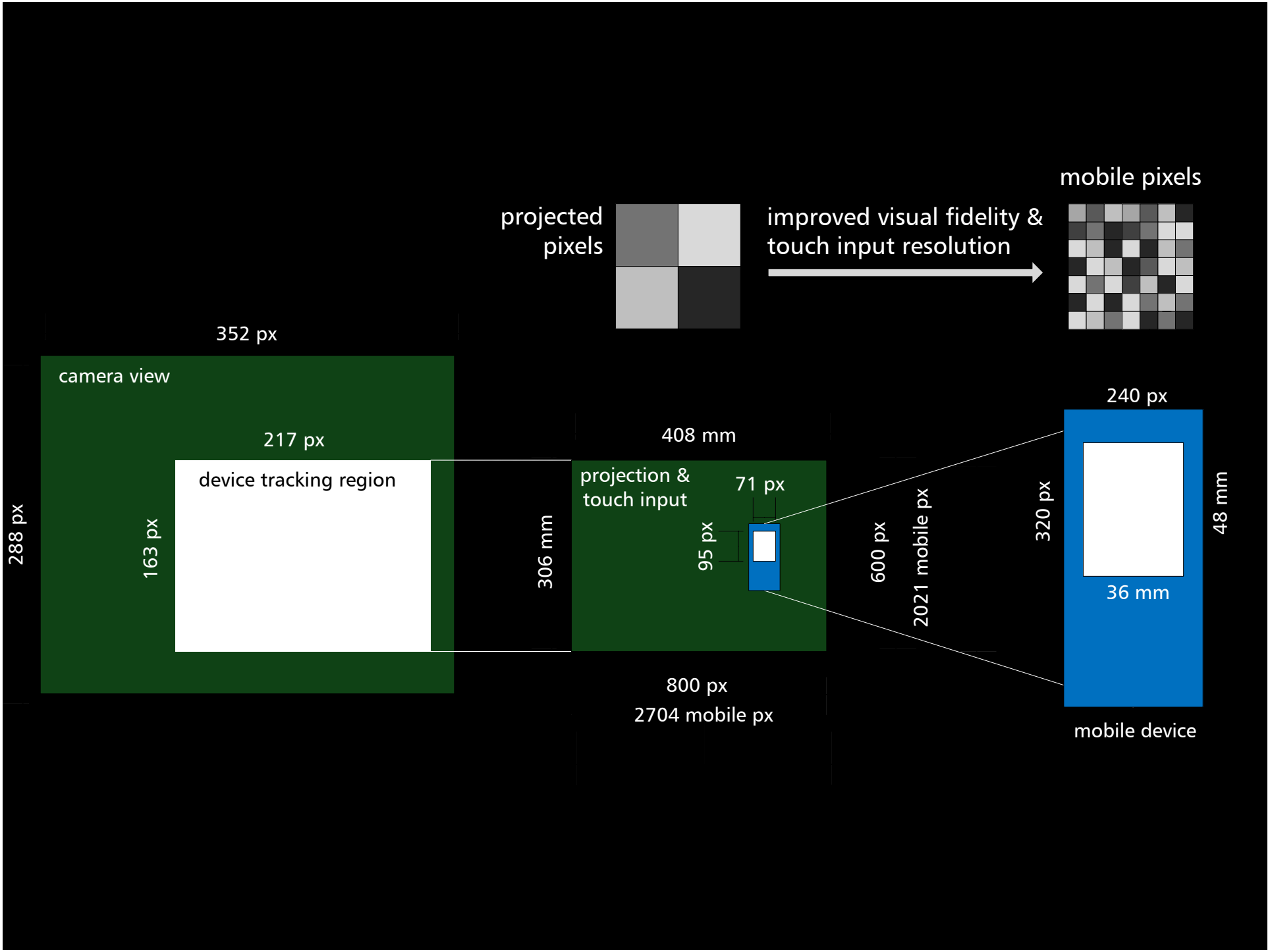
Enhancing interaction with large displays

TEI 2009 [Olwal & Feiner]
Proc. International Conference on Tangible & Embedded Interaction

INTERACT 2009 [Olwal]
Proc. IFIP TC13 Conference on Human-Computer Interaction

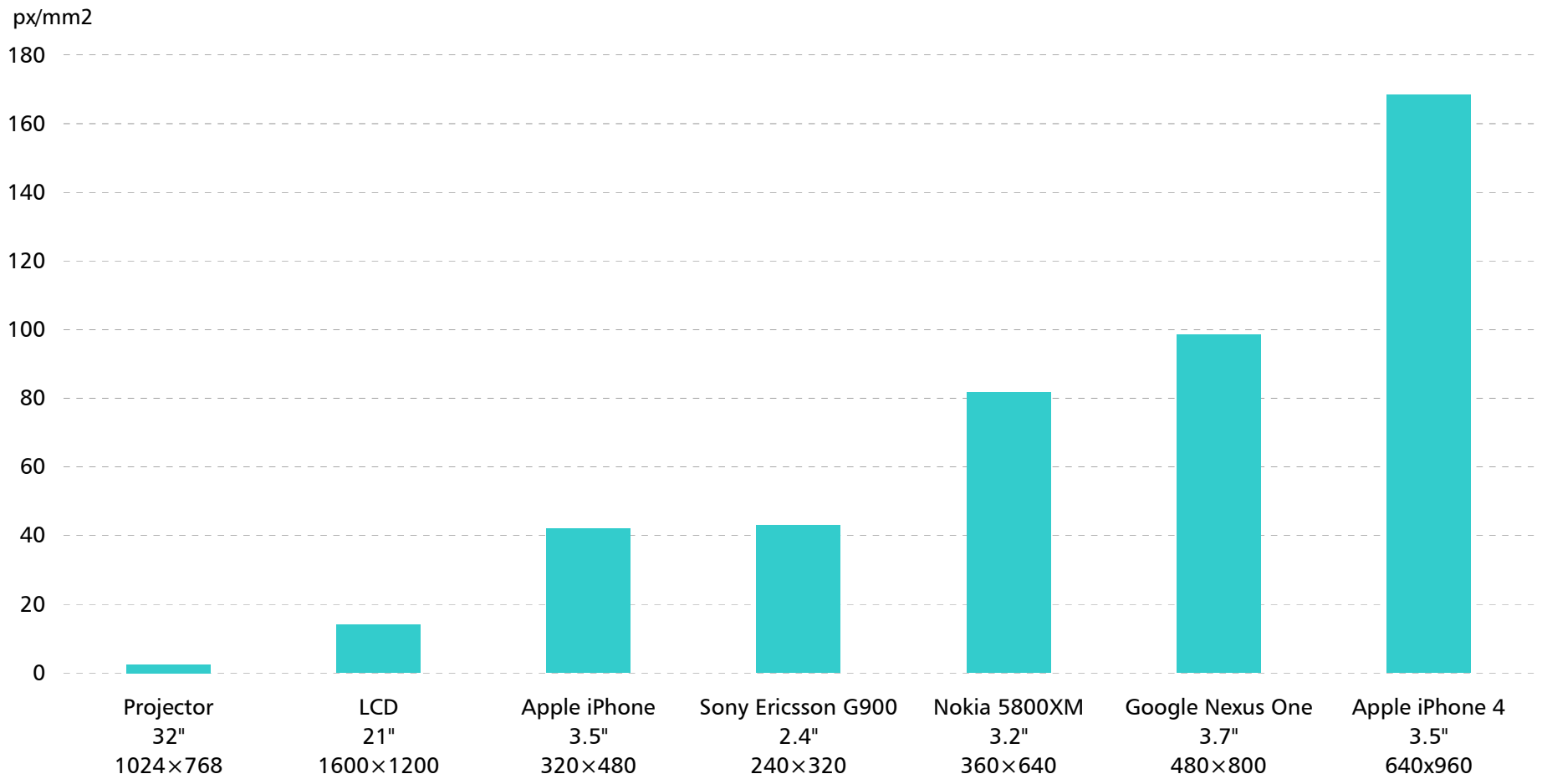
Ericsson Trade Show Events in 2009 / 2010
Barcelona, Las Vegas, Boston, Galway, Stockholm, Paris, Amsterdam, San Francisco


mobile device
touch-screen overlay
rear-projected surface
polarization filters
green filter
Camera
Projector


mobile pixels
projected pixels
improved visual fidelity & touch input resolution
352 px
camera view
217 px
device tracking region
288 px
163 px
408 mm
projection & touch input
71 px
95 px
306 mm
600 px
2021 mobile px
320 px
240 px
48 mm
36 mm
800 px
2704 mobile px
mobile device

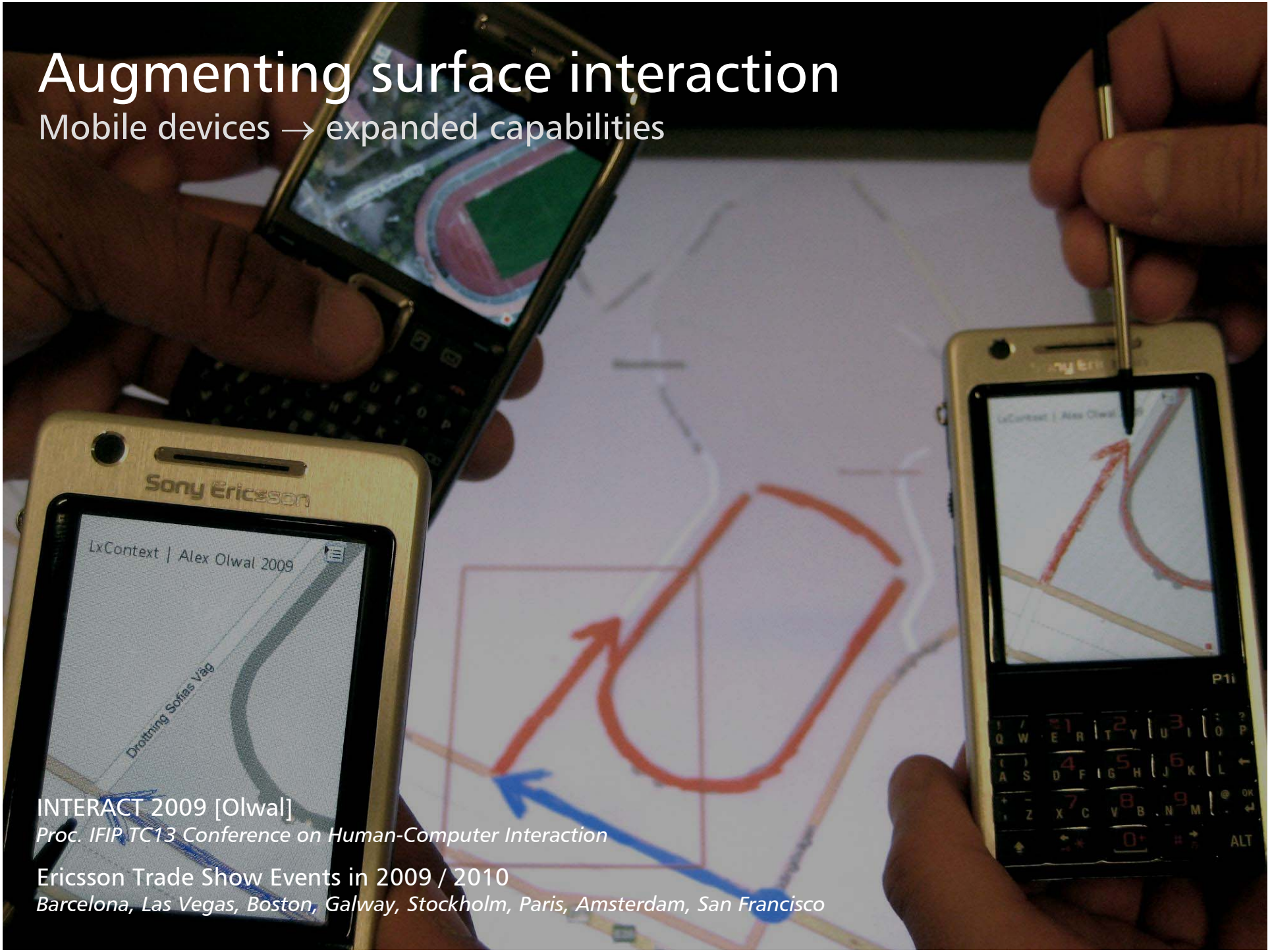
Resolution

Denser pixels & sensors on handhelds



Augmenting surface interaction

Mobile devices → expanded capabilities



INTERACT 2009 [Olwal]
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Augmenting surface interaction

Collaboration for multiple users, devices & locations

TEI 2009 [Olwal & Feiner]
Proc. International Conference on Tangible & Embedded Interaction

INTERACT 2009 [Olwal]
Proc. IFIP TC13 Conference on Human-Computer Interaction

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Hybrid interaction in unobtrusive AR

1. Unobtrusive
2. Sensing in environment
3. Novel display technology

AR, UbiComp, Mobile, Interactive Surfaces, …

Shopping window

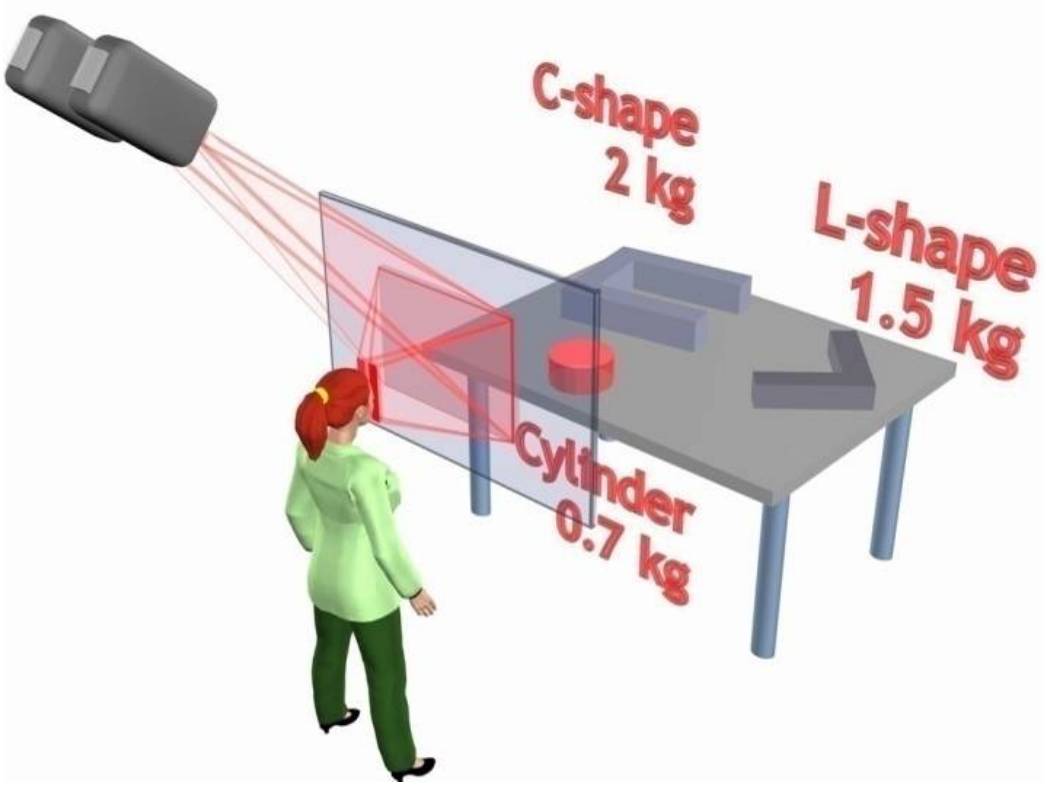
Microsoft Surface

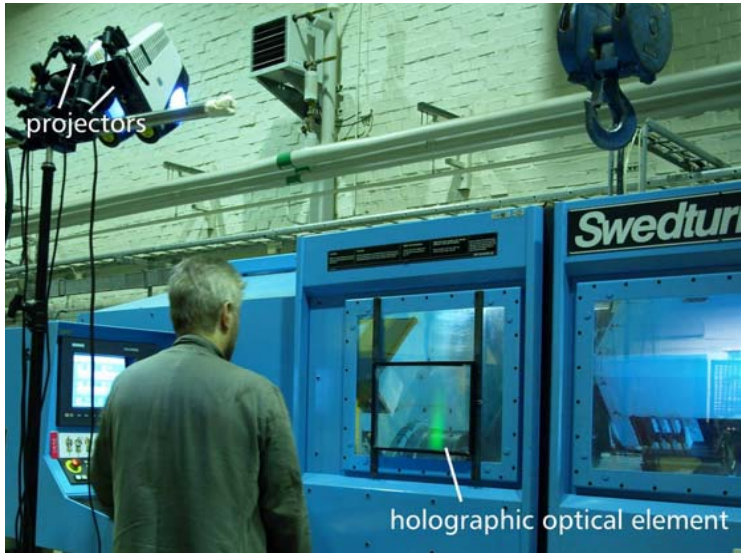
Microvision HUD

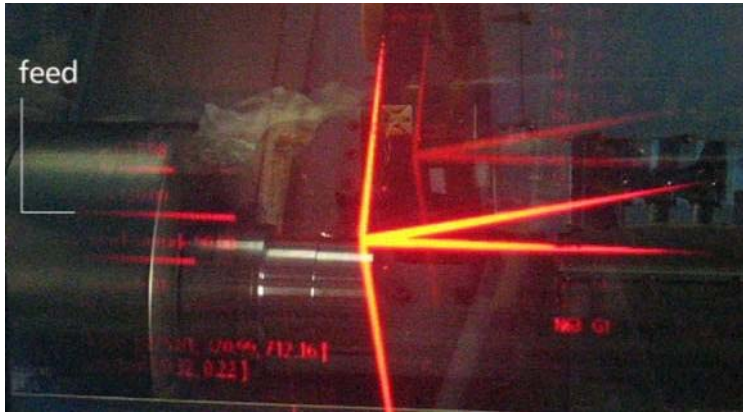
Heliodisplay, Mid-air

ASTOR

Transparent window with autostereoscopic 3D overlays







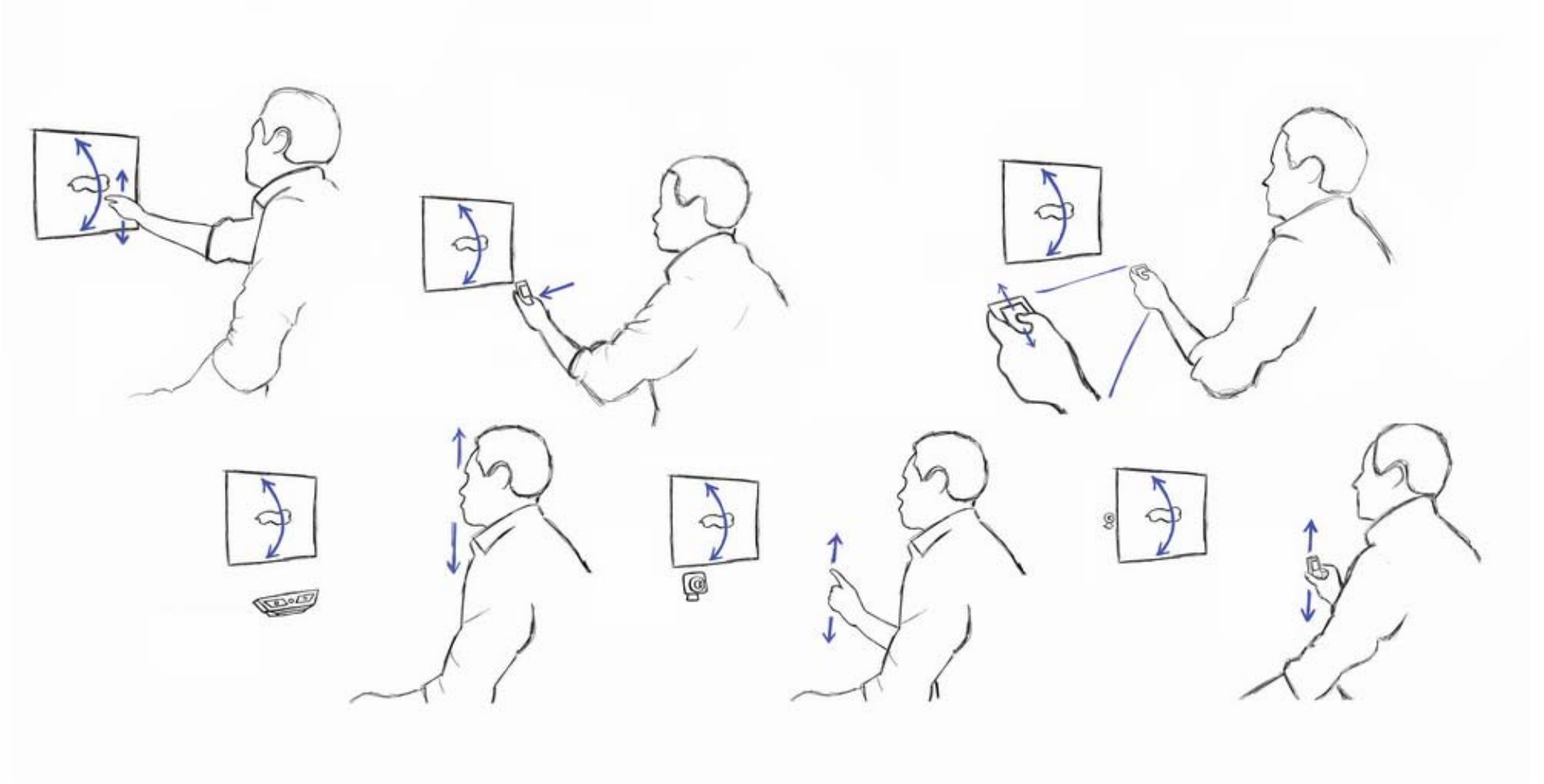
SPIE 2008 [Olwal, Gustafsson & Lindfors]
Proc. SPIE Electronic Imaging, Vol 6804

ISMAR 2005 [Olwal, Lindfors, Gustafsson, Kjellberg & Mattson]
Proc. IEEE & ACM Symposium on Mixed & Augmented Reality

SIGGRAPH 2004 Sketches [Olwal, Lindfors & Gustafsson]
International Conference on Computer Graphics & Interactive Techniques

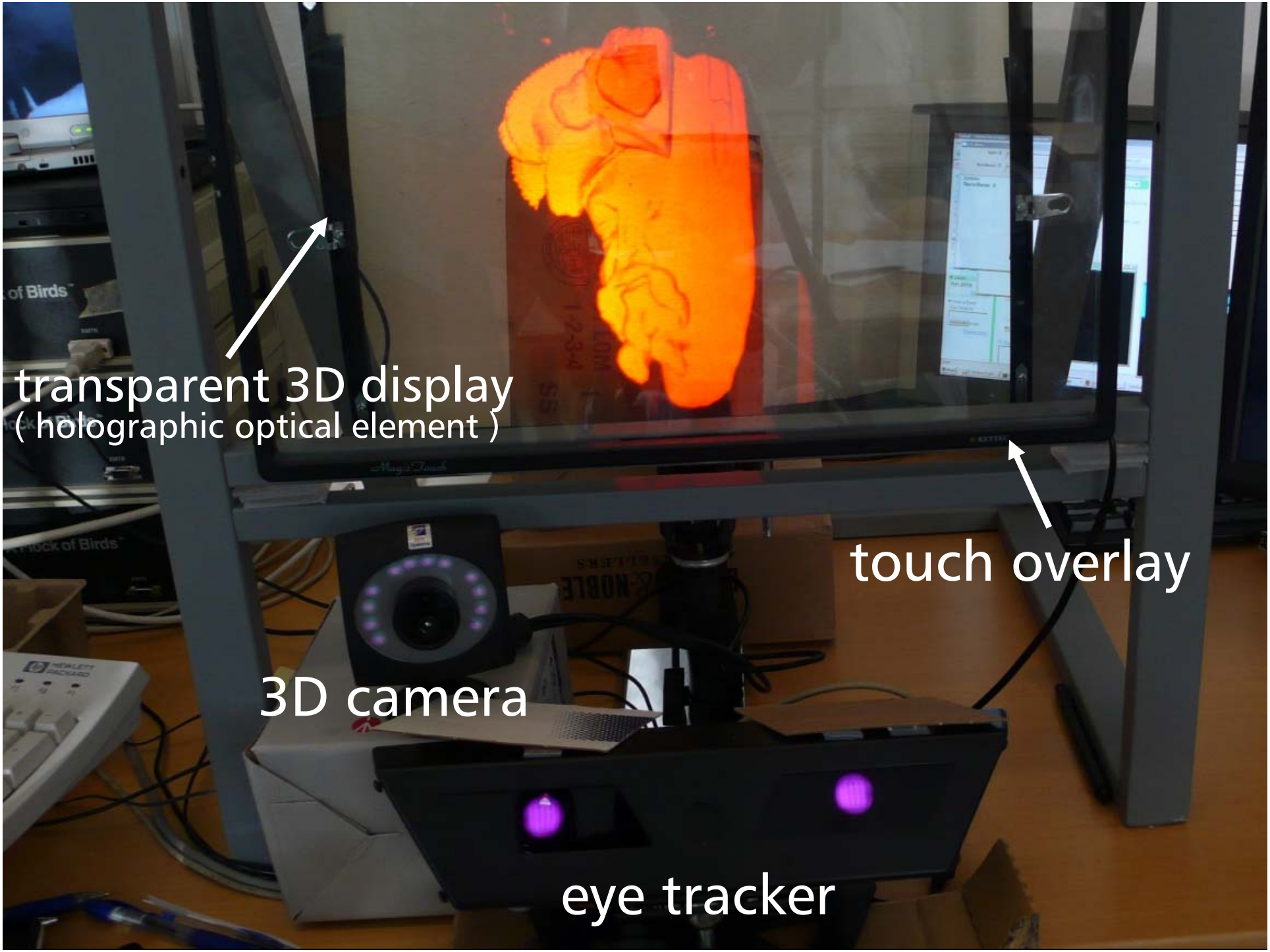
Unencumbered 3D interaction

Supporting walk-up-and-use for public displays



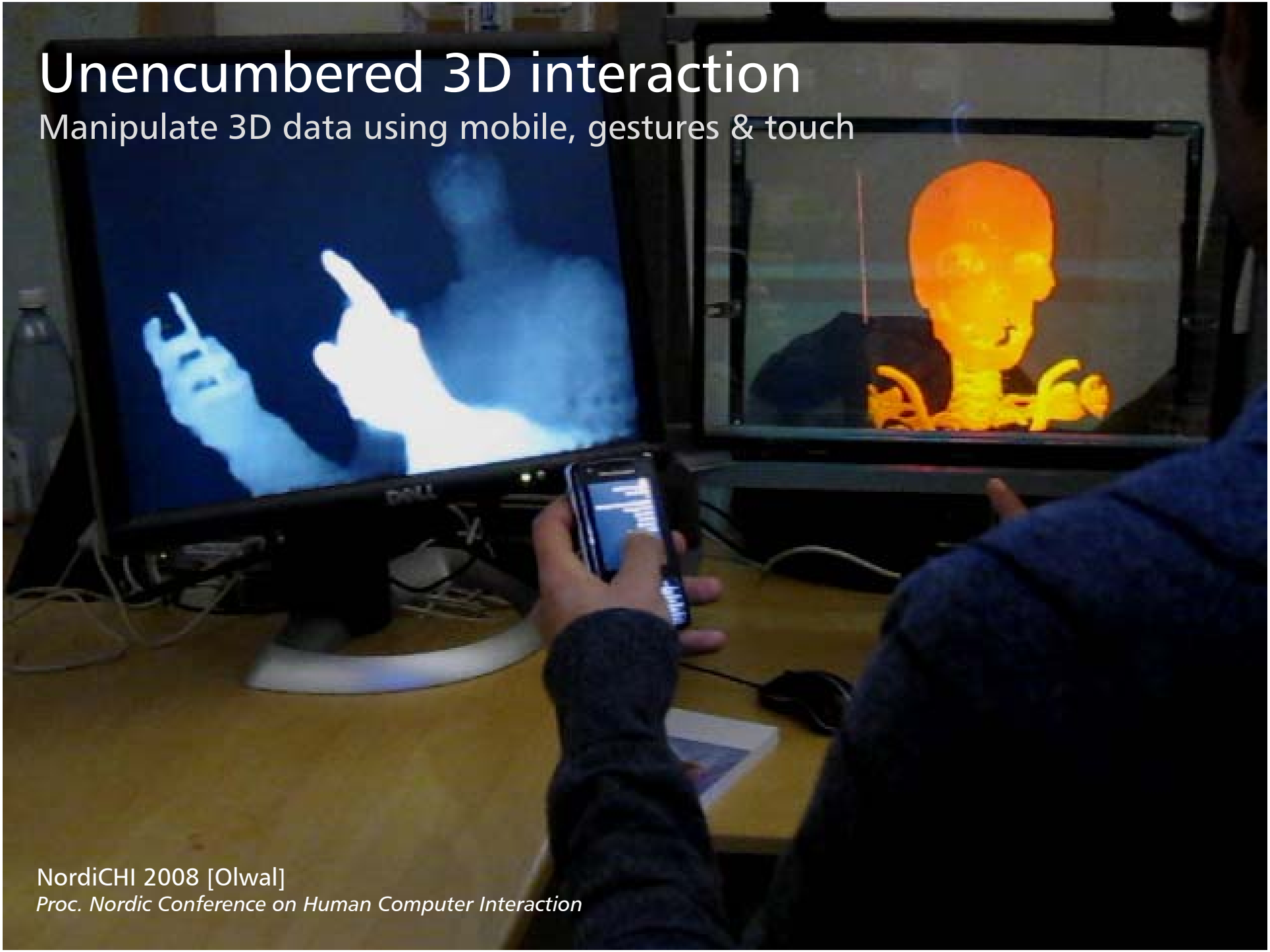
NordiCHI 2008 [Olwal]

Proc. Nordic Conference on Human Computer Interaction


transparent 3D display
(holographic optical element)
touch overlay
3D camera
eye tracker

Unencumbered 3D interaction

Manipulate 3D data using mobile, gestures & touch

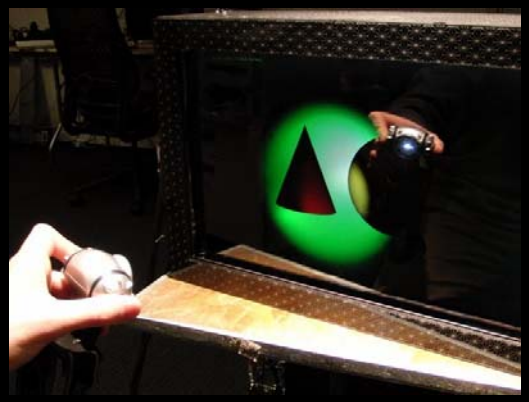


NordiCHI 2008 [Olwal]
Proc. Nordic Conference on Human Computer Interaction

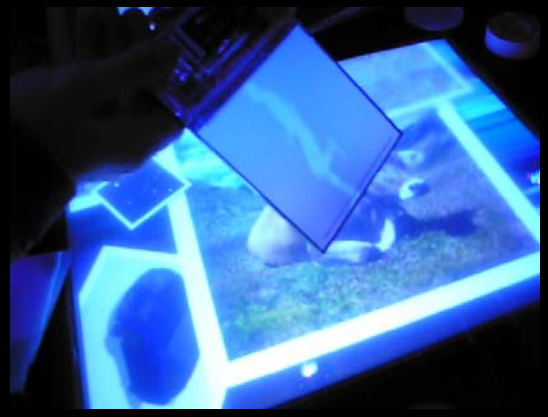
Hybrid interaction in unobtrusive AR

AR, UbiComp, Mobile, Interactive Surfaces, …

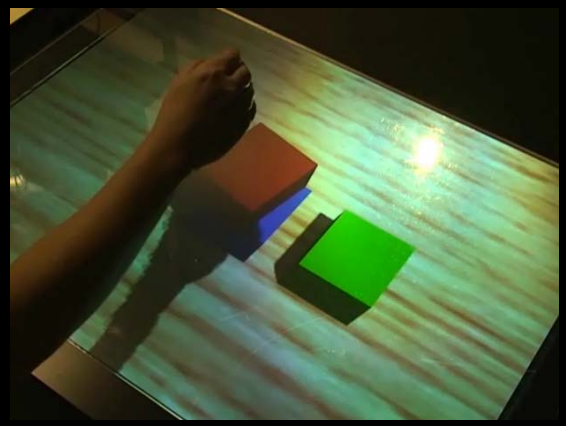
1. Unobtrusive
2. Sensing in environment
3. Novel display technology
4. Hybrid approaches → sensing / displays / interaction



BiDi: Flat depth-sensing displays
Hirsch, Lanman, Holtzman & Raskar 2009

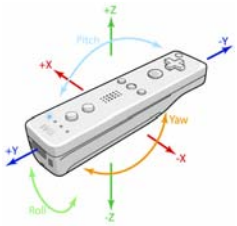


SecondLight
Izadi, Hodges, Taylor, Rosenfeld, Villar, Butler & Westhues 2008



Interactions in the air
Hilliges, Izadi, Wilson, Hodges, Mendoza & Butz 2009


Nikon
COOLPIX


+Z
Pitch
-Y
+X
Yaw
+Y
-X
Roll
-Z


XBOX 360

Acknowledgements

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- Department of Mechatronics
- VITA, Linköping University
- Computer Graphics & UI lab, Columbia University
- ilab, USCB

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- Swedish Research Council

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