Hybrid Interaction in Unobtrusive Augmented Reality

Alex Olwal, Ph.D.
olwal.com
Human-Computer Interaction, KTH
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

Shopping window  Microsoft Surface
LightSense
Dynamic augmentations of printed media

ISMAR 2006 [Olwal]
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 Artificial 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*
improved visual fidelity & touch input resolution

camera view

288 px

217 px
device tracking region

306 mm

408 mm

95 px

71 px

projection & touch input

320 px

36 mm

240 px

800 px

2704 mobile px
Resolution
Denser pixels & sensors on handhelds

<table>
<thead>
<tr>
<th>Device</th>
<th>Resolution</th>
<th>Pixels/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projector 32&quot;</td>
<td>1024×768</td>
<td>120</td>
</tr>
<tr>
<td>LCD 21&quot;</td>
<td>1600×1200</td>
<td>100</td>
</tr>
<tr>
<td>Apple iPhone 3.5&quot;</td>
<td>320×480</td>
<td>30</td>
</tr>
<tr>
<td>Sony Ericsson G900 2.4&quot;</td>
<td>240×320</td>
<td>25</td>
</tr>
<tr>
<td>Nokia 5800XM 3.2&quot;</td>
<td>360×640</td>
<td>30</td>
</tr>
<tr>
<td>Google Nexus One 3.7&quot;</td>
<td>480×800</td>
<td>60</td>
</tr>
<tr>
<td>Apple iPhone 4 3.5&quot;</td>
<td>640×960</td>
<td>120</td>
</tr>
</tbody>
</table>
Augmenting surface interaction
Mobile devices → expanded capabilities

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
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*

Ericsson Trade Show Events in 2009 / 2010
*Barcelona, Las Vegas, Boston, Galway, Stockholm, Paris, Amsterdam, San Francisco*
Hybrid interaction in unobtrusive AR

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

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
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

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
Acknowledgements

Organizers
• National Academy of Engineering
• The Royal Academy of Engineering
• European Council of Applied Sciences & Engineering

Collaborators
• Department of Production Engineering, KTH
• Center for Medicine, Health and Technology, KTH / KI / KS
• FunkIS (HCI + radiology research)
• Department of Mechatronics
• VITA, Linköping University
• Computer Graphics & UI lab, Columbia University
• ilab, USCB

Funding
• KK foundation
• Swedish Institute for Assistive Technologies
• Engineer’s Science Academy / Innovation Bridge
• Blanceflor Foundation
• Swedish Research Council

Equipment, donations & funding
• Ericsson, Nokia, Microsoft Research, Mitsubishi, Doro, …
Hybrid Interaction in Unobtrusive Augmented Reality

Alex Olwal, Ph.D.
olwal.com

Human-Computer Interaction, KTH