Towards Transparent Handheld See-Through Devices

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New Interaction Spaces
Transparent Displays Future Visions

Transparent Handhelds Future Visions


Today’s Technology


Previous Research

Contact AR

Pseudo-Transparency & Back-of-Device

Near-Field

tPad: Designing Transparent-Display Mobile Interaction by Hincapié_Ramos et al. 2014, Image from: https://www.youtube.com/watch?v=m933lfMzjpU


Our work: A Multi-Layered Handheld Display with Backsided Touch
Advantages

- Real see-through transparent displays can overcome limitations that arise through the simulation.
  - User perspective instead of magic lens views
  - No latencies of displaying the content behind the display
- Transparent displays enables volumetric and multi-layered content
  - Multi-layered interfaces
  - 3D applications and content
- New interaction spaces behind the device.
  - Touch
  - Gestures
  - Far-field

...but here some challenges arise.
Challenges

- Adaptive transparency
- Focusing & Binocular Disparity with Far Field AR
- Tracking
  - Contact AR
  - User perspective AR
Adaptive Transparency

The overlap of content and background on transparent displays not only impedes reading but all kinds of content that have to be clearly differentiate from the background.

Challenges

Adaptive Transparency

as suggested for HMDs by Kiyokawa et al.
Challenges

Focusing & Binocular Disparity with Far Field AR

By focusing the eyes on an object the brain is able to extract the spatial depth, but also produces two overlapping images of other objects with different distances. Depth-of-field blur and accommodation of the eye (the time of focusing) also impedes interaction between large distances.


Challenges

**Tracking using Contact AR**

Recent contact-based AR approaches use an external camera above the device to capture content from the surface, for example, from a paper sheet.

However, viable mobile devices must have a technology to perceive the appearance of the occluded surface.

Hincapié_Ramos et al. (2014), tPad: Designing Transparent-Display Mobile Interactions @ DIS 2014
Image from: https://www.youtube.com/watch?v=m933IfMzjpU
Challenges

Head-/Eye Tracking for User Perspective AR

To enable user perspective AR the user’s eyes (or head) has to be tracked to augment reality.

Image from: http://www.peterbryer.com/2013/02/is-future-of-smartphones-so-transparent.html

Unuma et al. 2014 - See-through mobile AR system for natural 3D interaction
Transparent displays in handheld devices enable
- new interaction spaces
- new fields of augmentation
- volumetric content

Challenges have to be overcome
- Adaptive Transparency
- Focusing & Binocular Disparity
- Tracking of Head & Device

But for most of this problems, there are technical solutions that just have to be build and tested.

Thank you very much for your attention!

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