Towards Spatially Aware Tangible Displays for the Masses

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Tangible Magic Lenses – Location-aware Displays
Concept: Spatially-aware Tangible Displays (above a Tabletop)

PaperLens (Layered Information Space)
[Spindler, Stellmach, Dachselt 2009]
Problem: Complex Setup in Research Labs
Spatial Input as a Powerful Interaction Channel
Our Vision: Tangible Displays with spatial input for the Masses

low-cost tangible display system that is

- easy to setup
- Robust
- Affordable
- Unobtrusive
Overview

1. Related Work
2. Application Domains
3. Passive and Active Displays
4. Technical Concept
5. Conclusion & Future Work
Part One

Related Work
Related Work

Chameleon
[Fitzmaurice 1993]

metaDESK
[Ullmer & Ishii 1997]
Related Work

Foldable Interactive Displays
[Lee, Hudson, Tse 2008]

PaperWindows
[Holman et al. 2005]
Related Work

LuminAR
[Linder 2010 – MIT Media Lab]
Related Work

LightSpace

[Wilson, Benko 2010]
Related Work

IllumiShare: Sharing Any Surface

[Junuzovic et al. 2012 – Microsoft Research]
Related Work

IllumiShare: Sharing Any Surface
[Junuzovic et al. 2012 – Microsoft Research]
Part Two

Example Application Domains
1. Exploration and Annotation of 3D Datasets
PaperLens (Volumetric Information Space)
[Spindler, Stellmach, Dachselt 2009]
Annotation and Navigation [Spindler & Dachselt ITS '09]

Annotations

Thumbnails

Height Indicator
2. Information Visualization
Tangible Views for Information Visualization
[Spindler et al. 2010]
Tangible Views for Information Visualization
[Spindler et al. 2010]
Tangible Views for Information Visualization
[Spindler et al. 2010]
InfoVis: Space-Time Cube

Change Visual Encoding by Flipping

Tangible Views for Information Visualization

[Spindler et al. 2010]
Part Three

Passive and Active Displays
Passive and Active Lenses
Passive and Active Lenses

- **Advantages:**
  - Arbitrary shapes, no display frames
  - Can show image content on front and back
  - Inexpensive, easy to reproduce

- **Disadvantages:**
  - Only work in complex setups
  - May suffer from poor image quality (depending on projection)
  - Occlusion (i.e., shadows) can be a problem
Passive and **Active Lenses**

### Advantages:
- High quality displays (e.g., retina display of 2012’s iPad)
- Do not require complicated projector setups
- Provide precise multitouch capabilities out of the box
- May contain additional hardware (accelerometers, NFC,...), adding further degrees of freedom to the interaction

### Disadvantages:
- are less flexible in terms of form factors
- Usually heavier, thicker, have display frames
Part Four

Technical Concept
Technical Concept

- **floor lamp**
- **ceiling lamp**
- **desk lamp**
- **desk**
- **tablet computer** (active display)
- **projection** (passive display)
- **everyday object** (passive display)
- **sheet of paper** (passive display)

Tracking Bulbs
Long-term goal:
- Use tracking bulbs in desk or ceiling lamps
- Combine passive and active lenses
- Tracking of everyday objects

Short-term goal:
- provide prototypic, affordable solution for *active* displays
- Extend PaperLens
Marker-less Tracking based on consumer hardware
- One Kinect for our prototype, fixed at the ceiling above the table surface

During Setup: coordinate system transform.

During Operation
- Location/orientation of iPad tracked in each frame
- Known shape of iPad used for segmentation
- Planar equation can be computed by well-established algorithms like RANSAC
- Plane transformed into the global CS
- Position and orientation of lens streamed to each device
- Self-tailored, VRPN-based protocol
Early Prototype
Conclusion & Future Work

- Concept for a low-cost system
  - for mobile, spatially-aware tangible displays
  - Tracking of active displays using off-the-shelf hardware
  - Easier setups, lower costs

- In the Future:
  - Combine active and passive lenses
  - Tracking of everyday objects for interaction
Questions?

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References


