Classifying handheld Augmented Reality: Three categories linked by spatial mappings

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Plan

• Introduction and scope
• Framework
• Dynamicity
• Future work
• Conclusion
Introduction: Academic Definition

- Academic definition [Azuma 97]:
  - Combines real and virtual
  - Interactive in real time
  - Registered in 3D
Introduction: Academic Definition

• Academic definition [Azuma 97]:
  – Combines real and virtual
  – Interactive in real time
  – Registered in 3D

• Specific to AR:
  – ‘Real’ AND ‘Virtual’
  – Spatiotemporal relationship between the physical world and digital content.
Introduction

• Augmentation is mostly visual
• AR is influenced by hardware
• So handheld AR has some specificities:
  – Viewpoint is controlled by device pose
  – Direct Touch is the de facto standard input (1:1 mapping with the screen)
• How to relax spatial constraint while keeping physical/digital colocation?
Introduction

• Scope: Visual augmentation in handheld Augmented Reality
• Focus on spatial relations
• Goal: Organize design alternatives in a framework
Framework Presentation

Framework organized around:

• 3 entities, 2 categories for on-screen content
• 2 spatial mappings
Representation of the Physical World

• On-screen content representing the physical surrounding

• Allows the user to map the viewpoint and digital augmentation in the physical world
Representation of the Physical World

• Mode of representation:
  – Live video, snapshots
  – Non-photorealistic
  – Virtual Model
Digital Augmentation

• On-screen content that is not the representation of the physical world
• Provide extra information and interaction
Digital Augmentation

• Visual aspect:
  – Reproduction Fidelity axis [Milgram 1994]
  – Dimensionality [Tönnis 2011]
Digital Augmentation

• Content:
  – Selection of content beyond de facto viewport visibility
  – Information filtering [Julier 00]
Distinction

Representation / Augmentation
Distinction

Representation / Augmentation

• ClayVision [Takeushi 2012]

• Distinction on a per-characteristic rather than a per-object basis
Spatial mapping between the physical world and its representation

• Coupling of the viewpoint with the handheld device pose.

• Projection:
  – Camera dependent, zoom
  – Distortion (e.g. Fish-eye)
  – Orthographic
Spatial mapping between the Augmentation and the Representation

• Spatial coupling of the augmentation with the representation of the physical world

• Relaxing this coupling is useful to improve augmentation legibility
Framework: Summary

- A snapshot at a given time
- Need for description of dynamicity and transitions
Dynamicity of the spatial mappings

• Initiative:
  – Explicit
  – Implicit
  – Automatic

• Sustainability:
  – Transient
  – Sustained
Dynamicity of the spatial mappings

• Spatial mapping between the physical world and its representation:
  – Freeze-frame implemented as explicit and sustained
Sample technique: AR TapTap

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

• Spatial mapping between the physical world and its representation:
  – Touch Projector: implicit and transient zooming
Dynamicity of the spatial mappings

• Spatial mapping between the representation and the augmentation:
  – Implicit

View Management [Bell 01]
Dynamicity of the spatial mappings

- Transient transitions interesting to best fit current user’s task
- Implicit transitions interesting as no extra user’s action is necessary
- To avoid discontinuity, transitions needs an assistance such as animation
Ongoing Work

• Validation and refinement:
  – Existing classifications
  – Existing interaction techniques and systems
  – Own experience
Ongoing Work

- Input modalities and spaces
  - Relaxed viewpoint control
  - Interaction with augmented scene
Future Work

• Generalization to other AR settings

<table>
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<tr>
<th>Display device</th>
<th>Physical World</th>
<th>Representation Physical World</th>
<th>Augmentation</th>
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Conclusion

• Framework:
  – 3 entities, 2 categories for on-screen content
  – 2 spatial mappings
  – Dynamicity of spatial mappings: Initiative, sustainability
Thank you for your attention

Questions ?