Enhanced Reality: A New Frontier for Computer Entertainment

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Enhanced Reality?

- Augmented reality but with an entertainment focus
  - Minimize encumbrance
  - Utilize common hardware
  - Simplify setup/calibration
  - Create an enjoyable user experience
Research Goals

• Natural User Interfaces
  – Allow people to interact in a more natural, enjoyable manner

• Real-time Special Effects
  – Enable people to experience for themselves the kind of special effects seen in the movies
Related work

• Many years of SIGGRAPH
  – Myron Krueger’s art exhibits
  – MIT media lab ALIVE system
  – Interval’s Magic Mirror

• Reality Fusion, ePlanet, etc.
  – Primarily use motion detection or background subtraction to create sprites
Current Setup

- Standard television set
- PlayStation2 for video processing and graphical rendering
- 1394 webcam (<$90 retail)
  - 30 frames/sec uncompressed video
  - 320x240 YUV422
  - 640x480 YUV411
Technologies

• Scene Interpretation
  – Participant tracking
  – 3D object tracking
  – Lighting estimation

• Rendering
  – Lighting
  – Compositing

• System
Participant Tracking

- Segmentation
  - Background subtraction

- Motion estimation
  - Optical flow
  - Feature tracking

- Part labeling
  - Face detection/tracking
    - A Survey on Face Detection Methods. Yang, Ahuja, Kriegman
  - Limb finding/tracking
    - A Survey of Computer Vision-Based Human Motion Capture. Moeslund, Granum.
3D Object Tracking

- Color-based tracking
  - Spheres
    - 3D position from centroid and radius
    - Rotation rate is also measurable using 2D visual flow at centroid
    - Illumination unaffected by rotation
    - Very fast and simple
  - Sphere and cylinders
    - 6 DOF tracking, SIGGRAPH 2000.
Lighting

• From a known sphere
  – Static
    • Inspired by Debevec’s work
    • High dynamic-range estimation possible
  – Dynamic
    • Real-time light source estimation
    • Real-time light map
Compositing

- Z-buffer rendering
  - Render the tracked sphere to Z-buffer only
- Alpha feathering
  - Render CG to texture, create an alpha stencil, blur the alpha stencil, render to screen
  - Still have z-buffer aliasing
Magic duel

- 3D color tracking
- Motion detection
- Figure segmentation
- Image distortions
- Compositing
System

- Use video as texture for a mesh
- Delay video to give time for processing
Virtual character: *Misho the witch*

- *Misho* stands on the red ball
- *Misho* likes to watch the green ball
- *Misho* tries to entertain herself (and you)
Virtual character: Seymour

- Seymour’s plane follows the green ball
- *Seymour* jumps out onto the red ball
- *Seymour* loses his balance if you move the red ball too fast
- *Seymour* jumps back in if his plane comes close
- Seymour’s plane always rescues him
Issues

• Lighting conditions
  – Insufficient ambient lighting
  – Extreme back-lighting (windows)

• Visual distractions
  – Mirrors
  – Movement, color
Conclusions

- Real-time movie special effects are coming soon
- Video input will be a part of future computer entertainment
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