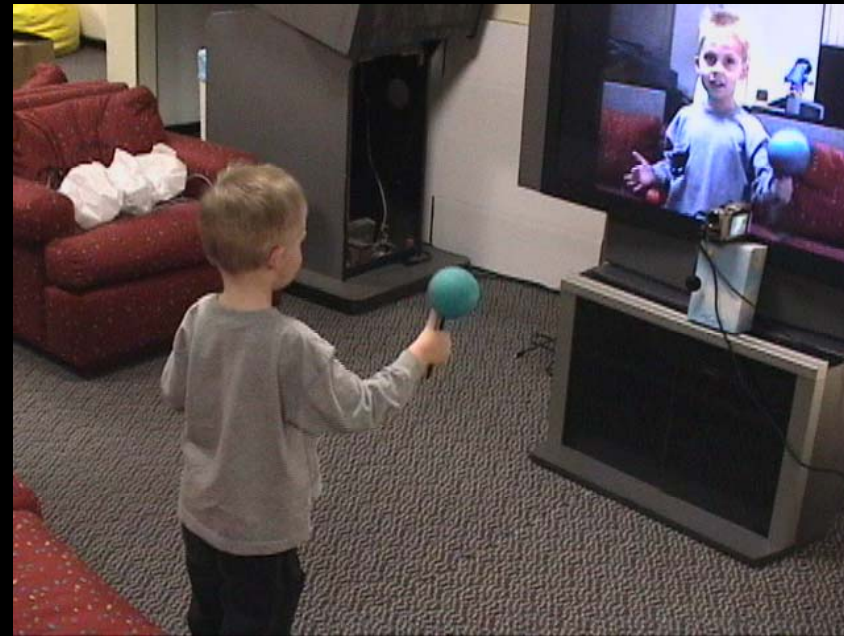


Enhanced Reality: A New Frontier for Computer Entertainment

Richard Marks

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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Q&A