Using Video Input for Games

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http://www.devnet.scea.com/research/index.htm
Why use video input?

• To create an interface that is:
  – Intuitive
  – Simple
  – Enabling
  – Enjoyable
Outline

• Introduction/background
• Video as input
• Enhanced reality
• Issues
• Conclusions
• Q&A
Intended audience

• Game designers
• Producers
• Programmers
• Artists
• Gamers
What this talk covers...

• Live video input as a critical component to game play
  – Technology
  – Ideas
  – Examples
  – Issues
and what it does not.

- Non-critical cool uses of video input
  - Texture/skin creation
  - 3D model creation
  - Easter egg bonuses
  - Reaction snapshots (like on a roller coaster or water ride)
  - High-score photos/movies
Video input

- Video As Input
  - Uses video processing as a replacement for joystick/keyboard/mouse
- Enhanced Reality
  - Combines live video and graphics to create an experience that directly involves the participant
Related work

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

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

• Demo
• User does not see the video
  – Video quality only important for processing
  – Only need to transfer/process useful info
• Framerate and latency are critical
• Immediate and obvious visual feedback is important
Video processing

- 3D object tracking (props)
  - Color-based
  - Shape-based
- Body tracking
  - Background subtraction
  - Motion tracking
  - Model fitting
- Facial tracking
Reasonable specs

• Real-time
  – 30 to 60 frames/second
  – Less than 3 video frames of latency

• Inexpensive
  – Camera cost-of-goods target <$20

• Modular
  – Easy to integrate into application
  – Predictable system impact
Current setup

• USB webcam (<$50 retail)
  – 30 or 60 Hz YUV422 video
  – 320x240 compressed, 160x120 raw

• Video processing
  – Decompression
  – Color thresholding, background subtraction, windowed centroid/moments

• Demo
Traditional game ideas

- Sports
  - Baseball, golf, tennis, ping pong
- Dancing
- Fighting
  - Weapons, body
- Flight sims
Medieval Chamber

- Sphere and cylinder color tracking
- Advanced rendering
- Physical simulation/collisions
Soaring

- Background subtraction, line fitting
- Arm angles and motion determine bank angle, attack angle, and airspeed
- Shadow wings mimic arms
New game ideas

- Bucket catch
- Juggling
- Air guitar
- Hand puppets
- Whack-a-mole
- Art creation (pottery wheel, painting)
Marionette

- Color-based tracking
- Character control can be mapped arbitrarily
Enhanced Reality

- User sees video, so quality is important
- Either add to or modify live video
- User and environment enhancements
- Augmented reality but with an entertainment focus
Current Setup

• 1394 webcam (<$90 retail)
  – 30 Hz YUV422 video
  – 320x240 uncompressed

• Video processing
  – Color thresholding, centroid/moments,
    lighting estimation, motion tracking

• Demo
Virtual character: Misho the witch

- Misho stands on the blue ball
- Misho likes to watch the red ball
- Misho tries to entertain herself (and you)
Virtual pets: butterflies

- Butterflies swarm after red objects
- Blue objects scare them off
- The chief butterfly lands to check it out
- Z-buffer-only rendering gives illusion of 3D

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Technologies

- 3D object tracking
- Participant tracking
  - Pixel-accurate figure segmentation
  - Motion estimation
  - Body-part labeling
- Lighting estimation
- Compositing
  - Z-buffer rendering
  - Alpha feathering
Future ideas

- Magic duel (head-to-head first-person video combat) for SIGGRAPH 2001
- Fun House
- Casper the ghost
- Teletubbies
- Superheroes
  - Fantastic Four (Torch, Invisible Girl, Mr. Fantastic, Thing)
  - X-Men (Cyclops, Wolverine)
  - Ironman, Silver Surfer, Spider Man
Issues

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

• Visual distractions
  – Mirrors
  – Movement, color

• Camera variance

• Field of view vs. resolution tradeoff
Conclusions

• Simpler interfaces are needed to reach a broader audience
• The interface should be considered during game design, and vice versa
• Game designers need to learn what is possible (similar to graphics)
Conclusions

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