Using Video Input for Games

Richard Marks

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

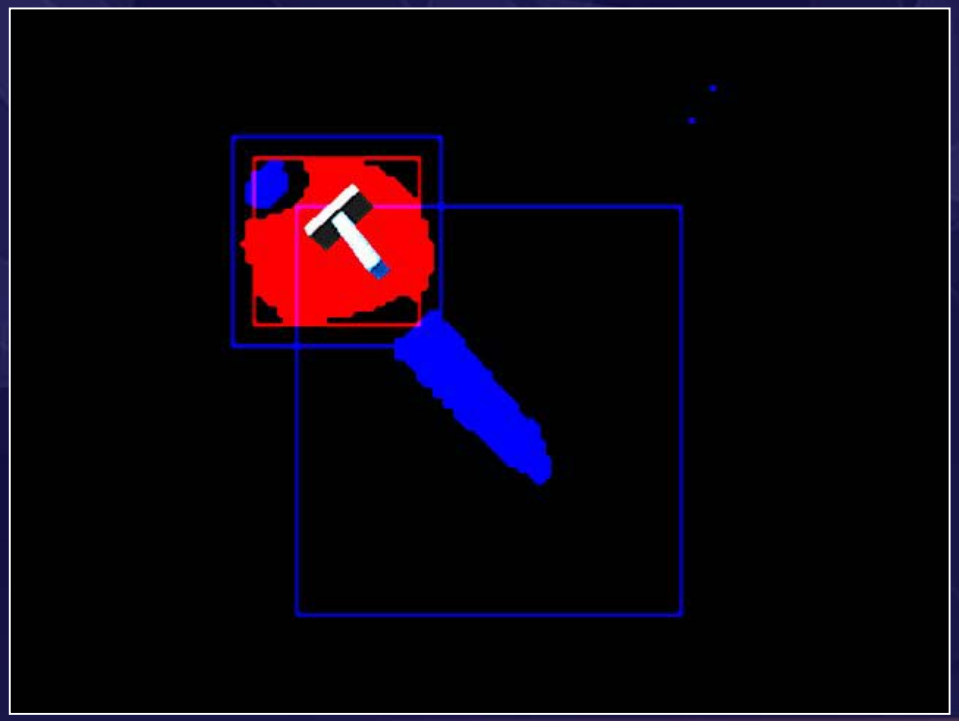
- USB webcam (<$50 retail)
  - 30 or 60 Hz YUV422 video
  - 320x240 compressed, 160x120 raw
- Video processing
  - Decompression
  - Color thresholding, background subtraction, windowed centroid/moments
- Demo

Traditional game ideas

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

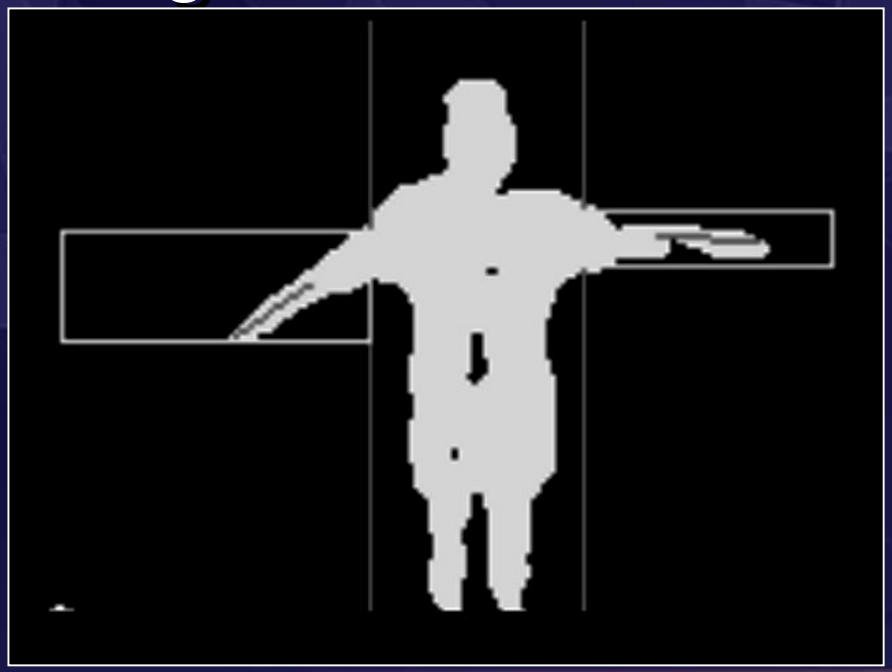
Medieval Chamber

- 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

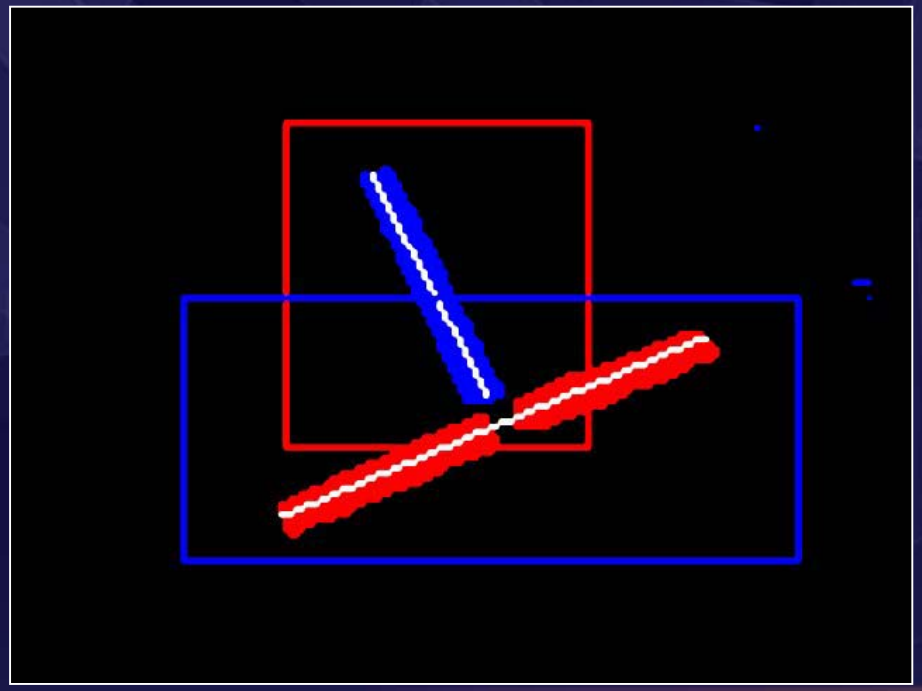


New game ideas

- 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

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

Q&A


SONY
COMPUTER
ENTERTAINMENT ™