Building Virtual Disney Worlds

Mark R. Mine
Walt Disney Imagineering
Research & Development Inc.
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Outline

• VR Studio Background/Overview
• Projects Overview
• Working with Designers, Case studies
• More Lessons Learned
• Future Directions
Overview

Walt Disney Imagineering
Research & Development, Inc.
VR Studio
VR Studio - Then

- Established in 1992 to explore the potential of VR technology for theme park attractions.
  - Aladdin’s Magic Carpet Ride

Mission Statement: Advance the frontier of visual quality and interactivity in computer graphics for the Walt Disney Company
VR Studio - Now

- Location Based Entertainment
- 3D/4D Visualization for Theme Parks
- Interactive Experiences for the home
- High-quality pre-rendered graphics and animation for TV and theme park attractions
DisneyQuest

- 5-story, 100,000-square foot “Interactive Extravaganza” operating in Orlando and Chicago
- Four “zones”
  - Score Zone
  - Explore Zone
  - Create Zone
  - Replay Zone
DisneyQuest

• 6 Main attractions emphasizing high-end, real-time, interactive, computer graphics
  • Cyberspace Mountain
  • Invasion! An Alien Encounter
  • Ride the Comix
  • Virtual Jungle Cruise
  • Aladdin’s Magic Carpet Ride
  • Hercules in the Underworld
Aladdin’s Magic Carpet Ride
Hercules in the Underworld
Pirates of the Caribbean
Working With Designers

• Challenge: Overcoming the Designer’s resistance to change
• Competition: Proud tradition of physical model building
  • High level of detail works of art
  • Simultaneous, low-latency, perspective correct viewing by unlimited viewers
The Case for VR

Virtual simulations offer several key advantages over existing techniques:

• Rapid modifications to existing models
• Interactive sight-line evaluation
• Macro and micro scales in same model
• Visualization of complex behavior
  • Wave effect for Paradise Pier
  • Tigger Bounce for Pooh’s Hunny Hunt
The Disney Advantage

Why VR works at Disney:

• Large-scale, high-cost construction projects benefit greatly from VR
  • Unique designs
  • Customized materials
  • Specialized construction techniques

• In-house artistic talent helps maximize effectiveness of our VR visualizations
Case Study: Paradise Pier

- One of three major sections of Disney’s California Adventure (opening 2001)
- Initially hired to visualize coaster launch wave effect
- The power of 3D visualization obvious early on
  - Design flaws identified and corrected early in the design cycle
Paradise Pier Visualization

- Interactive 3D model enables multiple forms of visualization:
  - Designer walkthroughs
  - Ride simulations
  - Sightline analysis
  - 4D simulations (3D model + time) for construction planning/visualization
    - http://www.stanford.edu/group/4D/4D-home.htm
Paradise Pier & R&D CAVE
Paradise Pier Video

Paradise Pier Flythrough and 4D Simulation
4D Construction Simulation

- Facilitates exploration of resource/workforce allocation (work shielding)
- Helps avoid costly design errors and last minute changes in the field
- Goal is a womb-to-tomb system organized around 3D model
  - Central repository for all construction, operations, and facility information
Paradise Pier

- Amortize cost of building 3D model by reusing models in multiple simulations
  - Lagoon show design/development
  - Crowd flow simulation/analysis
  - Rescue/safety simulation/analysis
Lessons Learned

The importance of CAVEs as a display medium

• Large number of simultaneous viewers encourages interactive design sessions
  • Demos into Design Sessions

• Powerful communication tool
  • Paradise Pier pre-bid

• Externalizes discussions
Case Study: Pooh’s Hunny Hunt

- Major attraction developed for Tokyo Disneyland (opening 2000)
- Originally hired to visualize Tigger bounce effect. Can we make the guests feel like they’re bouncing with Tigger?
  - 1 bouncing car
  - 2 layers bouncing scenery
  - 4 layers bouncing video
Pooh’s Hunny Hunt Video

Tigger Bounce Simulation
**Pooh’s Hunny Hunt**

- Simulation effort quickly expanded to include verification of ride timings
  - Free-ranging computer controlled vehicles
  - Too complex for miniature cameras/models or pre-rendered visualizations
- VR simulation enabled designers to quickly evaluate ride profiles from the guest’s perspective
  - 2D ride planning tool misleading
Overhead View
Guest’s Perspective
Pooh’s Hunny Hunt Video

Free-Ranging Vehicle Simulation
Pooh’s Hunny Hunt

3D Model also utilized in multiple ways:

• Sightline verification used to validate reduction in number of audio-animatronic figures

• Real-time model used in planning of media development
  • Audio timing
  • Tigger bounce visuals
Lessons Learned

**CAVEs as a display medium (again)**

- The importance of first person perspective for ride timing verification
- Multiple users
- **Powerful communication tool**
  - Selling Hunny Hunt to Oriental Land Company
More Lessons Learned

The importance of in-the-world tools

• Object placement/control tools
• Curve editing for camera/object paths
• Animation controls

Need to better span the space of display devices!

• Tools which work from desktop to CAVE
More Lessons Learned

*The importance of physical interfaces…*  
*Especially for facile camera control*

• Aladdin’s flying carpet interface  
• Pirates steering wheel  
• Controls for simulation and pre-viz
More Lessons Learned

The importance of late-binding languages

- Interactive scripting layer (based upon Scheme/Squeak) on top of high-performance C++ layer
  - Rapid implementation/iteration of dynamic environments
  - On-the-fly GUI building critical for flexible simulation control.

Impossible to know what designer wants
Future Directions

DIRECT: Disney’s Interactive Real-time Environment Construction Tools
DIRECT

• **Hardware**
  • Rear-projection desktop with pen-based input
  • Large FOV stereo projection screen for immersive viewing
  • 6 DoF tracking for head-tracked stereo and direct manipulation
  • Flexible device layer for incorporating joysticks, buttons, and other physical controls
DIRECT

• Features
  • Intuitive direct manipulation interface for placing and sizing of 3D objects
  • Late-binding scripting layer for flexible control of dynamic simulations
  • Powerful tools for 3D curve editing and camera control
Future Directions

- Fourth generation open-source VR software system
- Real-time 3D rendering
- Incorporates powerful tools for rapid prototyping
  - based on DIRECT and Squeak
- Will run on any platform (PC, Dreamcast, PlayStation2, etc.)
- Visit http://www.panda.org for more details