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Authoring & Delivering MR Experiences

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Topics

- Context
- Experiences
- Story Engine
- Other Engines
- Science

Context

What and Why?

Cross Reality

AUGMENTED REALITY



COMBAT REALITY



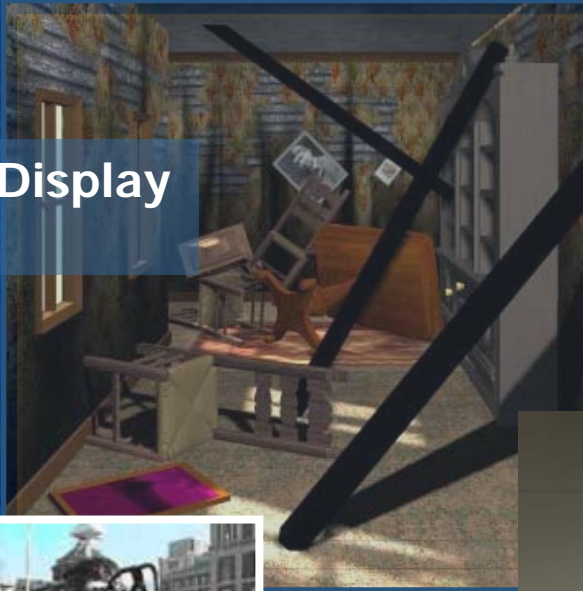
VIRTUAL REALITY



AUGMENTED VIRTUALITY

Cross Reality Capabilities

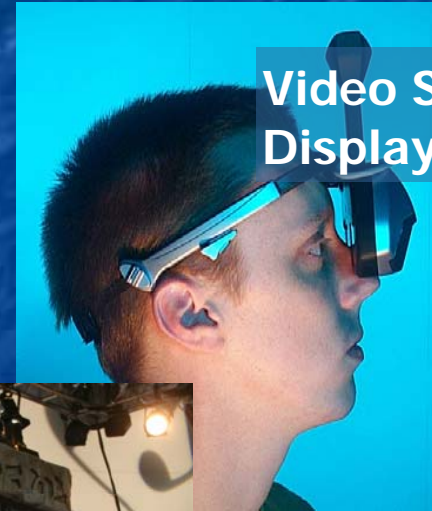
Virtual Display



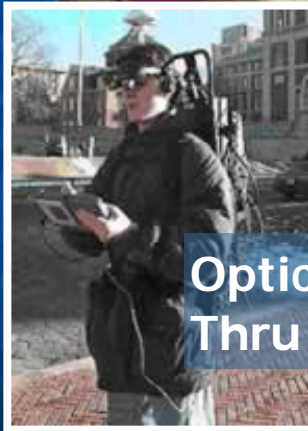
Handheld

Vienna University of Technology

Video See-Thru Display



Optical See-Thru Display



Desktop and Embedded Projection Display



MR Experiences

**Examples of what we have
delivered**

MR MOUT

- Training with high stress
- Can use for human factors studies on new situational awareness paradigms
 - Don't field it until you test it.

VR Actors

VR Sets

Vehicular

Sniper

HUD

CGF

SFX

Hostiles

FFW

MIXED REALITY

MILITARY OPERATIONS IN URBAN TERRAIN

MOUT

**MR MOUT
STC 360°
SET**

MR MINI-MOUT



MOUT 2 Video



Trailers and Previsualization

- Time Portal is an interactive movie trailer; can provide hype for movies
- Previsualization used in current movie creation, but MR adds new dimensions
- Details in next talk

MR Virtualization

- Virtual models in real settings
- Extension to scientific visualization
 - Real props
 - Collaborators
 - Multiple POV of common model(s)
- Details in next talk

MR Story Engine

Creating and delivering the
experiences

Agents

- Every object that has state, behaviors or interactions has an associated software agent in the Story Engine
- Agents can delegate behaviors to others
 - Can explicitly include/exclude inherited states or behaviors
- Agents have peers in the Graphics, Audio and SFX Engines, if appropriate

Scripting

- XML-based scripting
 - Behaviors with guarded cases
actions (invoked by communiques), triggers (time based), guarded reflexes (every cycle)
results change states for next cycle
- Plug-ins
 - AI Behaviors
 - Multiple physics engines
 - Pluggable-interfaces
- Advanced procedural scripting

Behaviors

- **Motivation-based AI**
 - Agents will respond to your interactions
 - Agents will respond to each other
- **Example: Path-based travel with ray-tracing for field-of-vision**
 - Path planning provides control stream
 - Ray tracing alters behaviors to react to environment
 - If you attack me, I'll attack you

Customization

- Customizable agents
 - Use delegation to get basic behaviors
 - Customize by overriding behaviors or setting parameters
- Auxiliary Physics Engines
 - Pathfinding APE
 - Raytracing APE
- Remote Device Interfaces
 - Connect any number of mice, keyboards, control sticks, or other mechanisms through this device-abstraction and network-based interface
 - Customizable device interfaces
 - Reload feature for user's gun
 - Grenade launcher
 - grenades that bounce (physics engine)

Features

- Reusable components
 - Build new scenarios from agents & resources of existing ones
- VR and MR domains
 - Same scenario can operate in either manner
- Multiple viewpoints
 - Others can watch
 - Can have cameras to give different POVs.
 - fixed or tracked
- Audio engine
 - 2-way radio (hardware and integration with sound system)
 - Multi-tier audio server
 - Audio delivered based on speaker constraints
- SFX Engine

More

- Calibrate set from within experience
- Support divers, swimmers, waders
 - Users, trainers, observers
- Log and playback
 - After action review
 - Rehabilitation

Architecture

- **Modularized – all services can be distributed**
- **Runs on multiple platforms (tested on Linux and Win/XP)**
- **Communication Protocol**
 - **Control Stream (position and orientation)**
 - Can come from SensorServer
 - Can come from real-time accurate physics engine
 - Can come from another agent
 - **Command Stream (high-level actions)**
 - **Data Encapsulation Format (DEF)**
 - Serialization and encapsulation of data

What Physics Engines Control

Element	Parts	Units
.location	.x .y .z	mm
.orientation	.yaw .pitch .roll	°
.linearVelocity	.x .y .z	mm/s
.linearAcceleration	.x .y .z	mm/s²
.angularVelocity	.yaw .pitch .roll	°/s
.angularAcceleration	.yaw .pitch .roll	°/s²

Flexibility

- **Bidding based allocation of rendering resources**
 - **Level-of-Detail management uses bids based on distance from user**
 - **In general we can support rendering schemes as diverse as ones based on story**

MOUT 3.0



MOUT3 Video



Other Engines

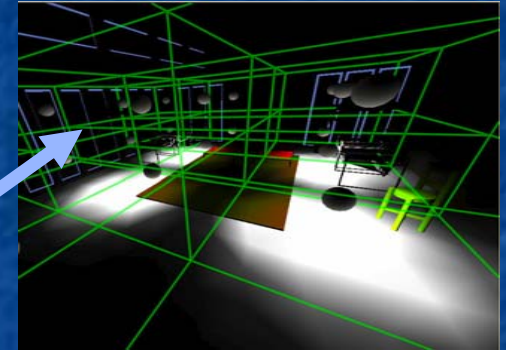
The delivery parts

The Software Engines



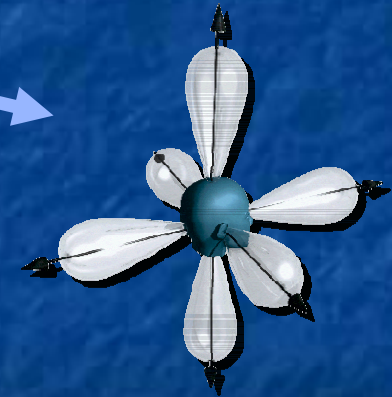
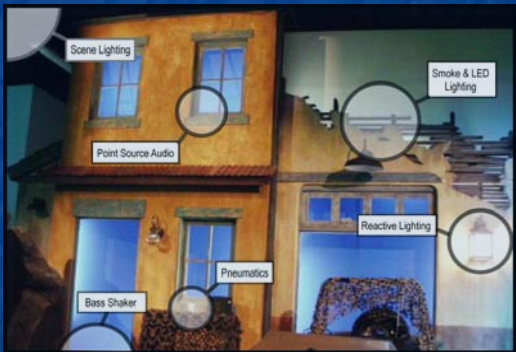
■ Story

■ Graphics



■ Audio

■ SFX



All are Platform Neutral

Graphics Engine

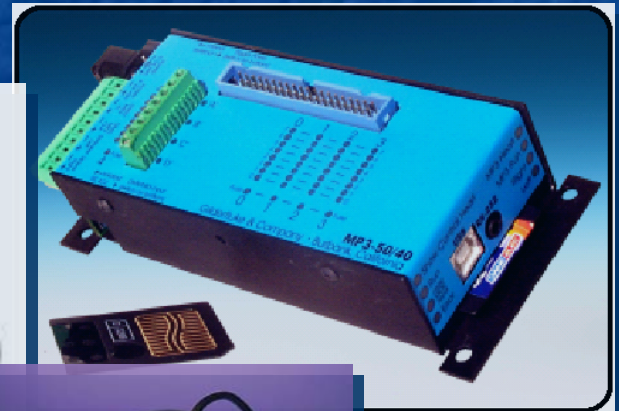
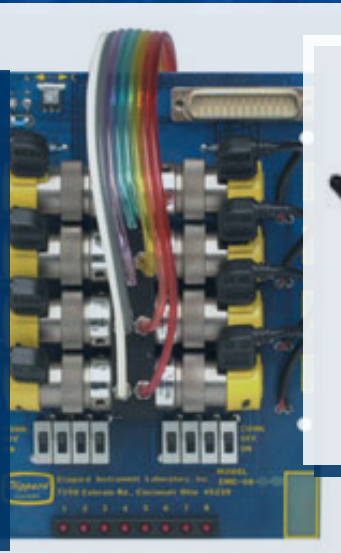
- OSG
- Cal3D
- Agent peers
- Occlusion
 - Impostors
 - Matte support

Audio Engine

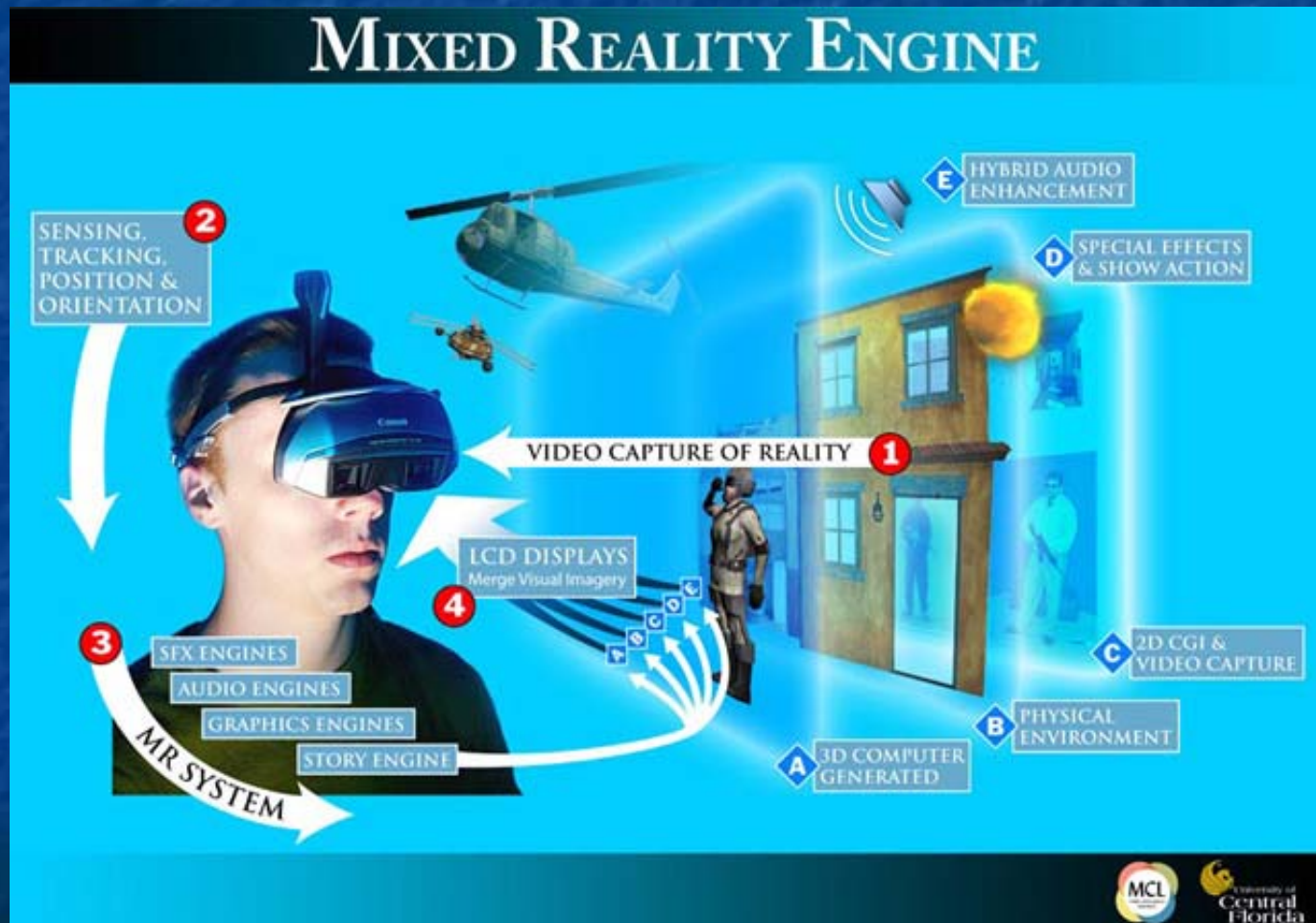
- Ambient, point, dynamic (3d moving)
- Constrained based on speaker placement
- Agent peers

Special Effects

- Colorkinetics SmartJack3 (USB to DMX)
- Colorkinetics JuiceBox2 / iColor MR Lights
- Gilderfluke MP3-50/40
- 4 Channel Dimmer Packs
- Pneumatic / Smoke System
- Sound Transducers ("Bass Shakers")



Integration of MR Engines

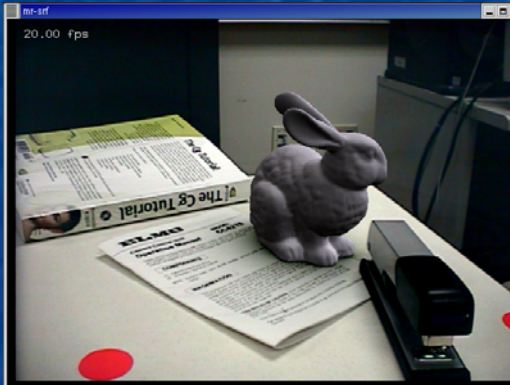


Future

- Story-based rendering
- Develop visual authoring interface
 - MR Backlot
- Integrate shadow/illumination work
- Run stories on PDAs
- Perform human factors experiments
- Create multi-player scenarios
- Go outdoors

Contributing Science

Melting the Boundaries in real-time



Blending the Real and the Virtual

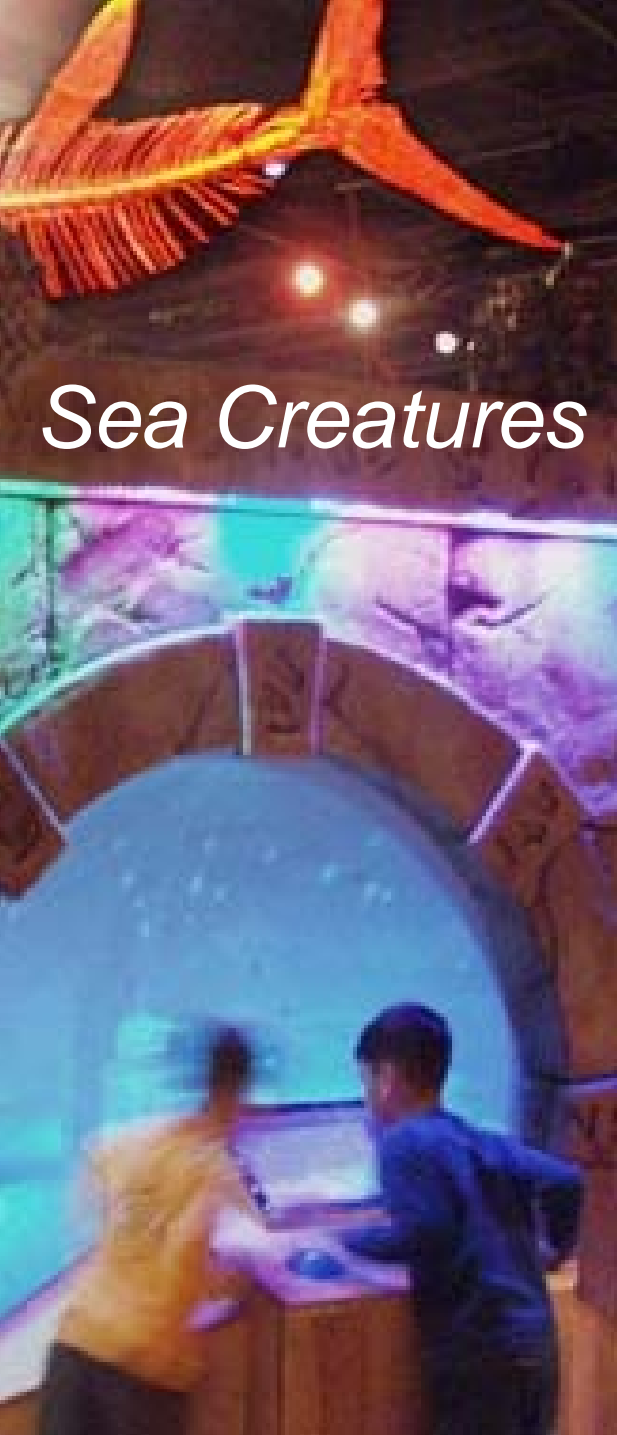
- Lighting (SNP)
- Virtual light on real/virtual objects
- Real light on virtual objects
- Shadows
- Cast by virtual objects on real/virtual objects
- Cast by real objects
- Fire
- Creating light and shadows on real/virtual
- Use color-transfer for ambient lighting (ER)

Fire/Shadows



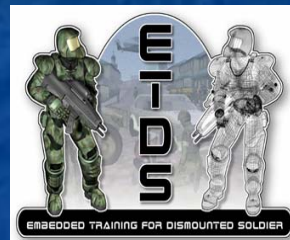
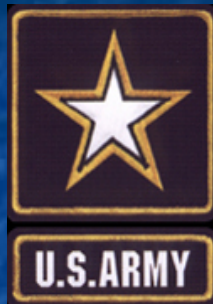
Pegasus in CSB





Sea Creatures

We wish to thank our partners



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Joint use Simulation Training Center

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