Shared Imagination: Creative Collaboration in Mixed Reality

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Examples

- **Team performance training**
- **Emergency planning**
- **Collaborative design**
- **Experience modeling**
- **Scientific virtualization**
- **Guided rehabilitation**
- **Science Center groups**
- **Entertainment (design and experience)**

What We Must Support

- **Jointly visualized "what if?" scenarios**
  - **Face-to-face interactions**
  - **Alternative POVs**
  - **Personal and group creation**
- **Enablers**
  - **Tangible and tactile components**
  - **Constructive distractions (sandboxes)**
  - **Shared display (1st & 3rd person views)**
  - **Shared audio landscape**
  - **Scalability, interoperability & portability**

MR Contexts

- **Physical Reality (PR)**
  - **real world**
- **Virtual Reality (VR)**
  - **purely synthetic**
- **Augmented Reality (AR)**
  - **virtual assets registered in real world**
- **Augmented Virtuality (AV)**
  - **real (people, props) layered in virtual space**

Mixed Reality Continuum

Physical Reality — Augmented Reality — Augmented Virtuality — Virtual Reality
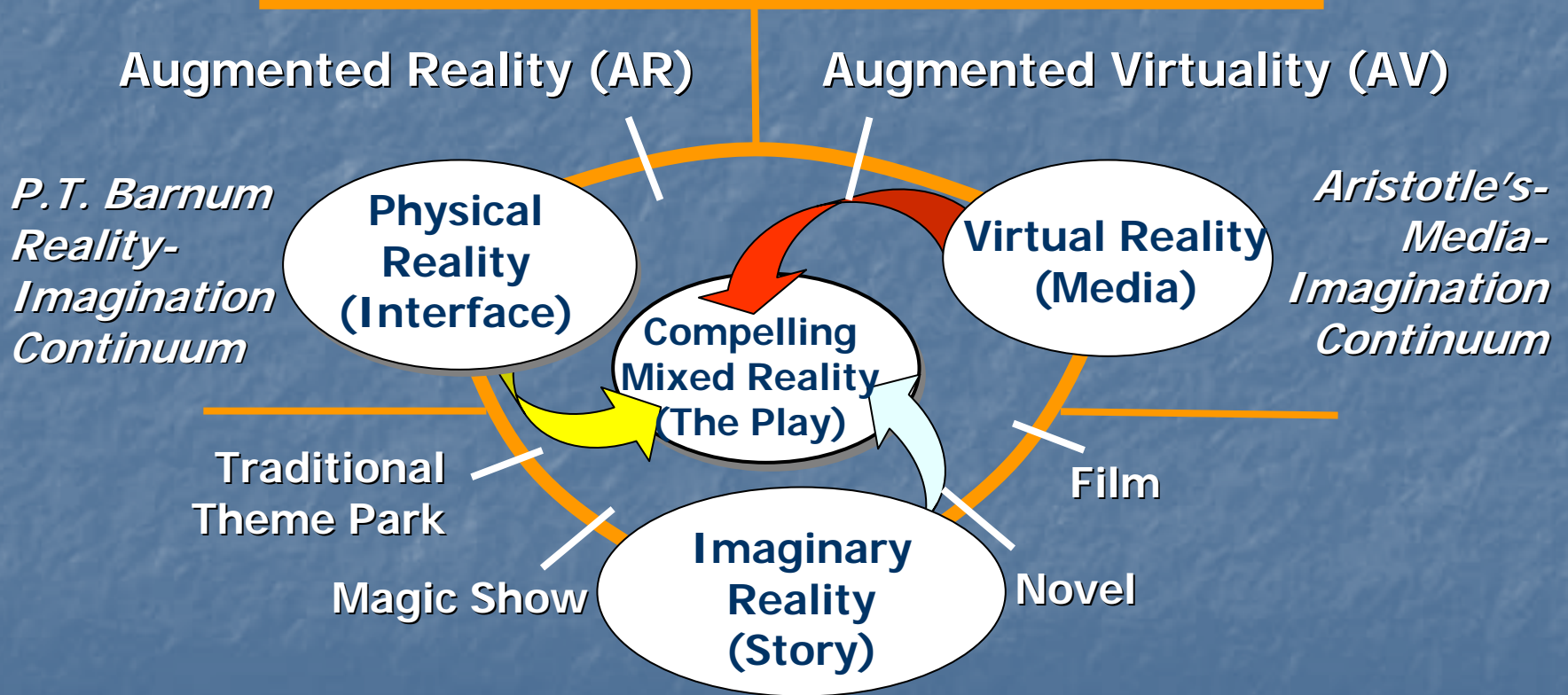
Creative Process in MR

- **PR is constrained by physical space**
- **VR limits person-to-person expression and context of PR**
- **AR and AV support rich layering**
- **Collaboration often requires moving smoothly along the MR continuum**

Milgram + Imagination
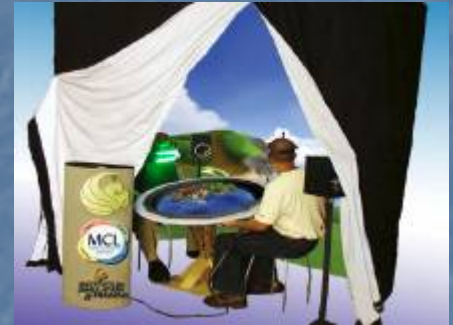
Milgram's Reality-Virtuality Continuum

Augmented Reality (AR)　　Augmented Virtuality (AV)

P.T. Barnum Reality-Imagination Continuum

Physical Reality (Interface)

Virtual Reality (Media)

Aristotle's-Media-Imagination Continuum

Compelling Mixed Reality (The Play)

Traditional Theme Park

Film

Magic Show

Novel

Imaginary Reality (Story)

Visual Rendering / Capture

HMDs

Dome Screens

Demo Dome

Optical

Flat World

MR Windows

Video

Light capture

MR Video See-Through

Audio Capture / Rendering
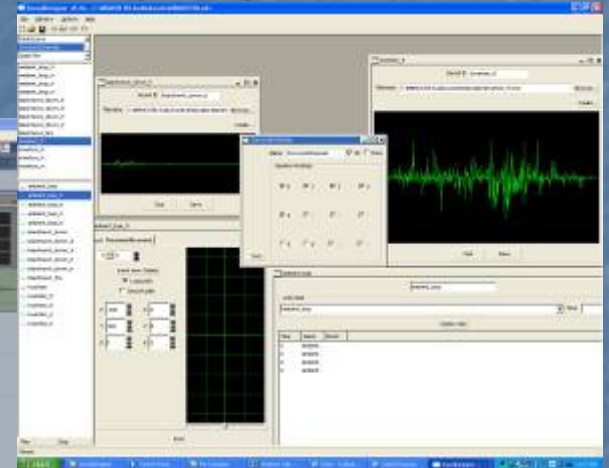
Surround Hydrophones

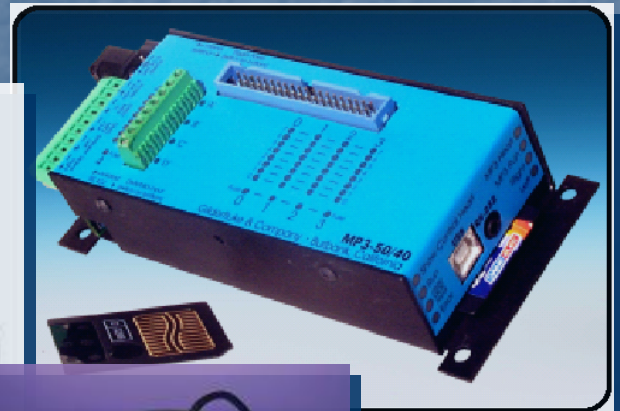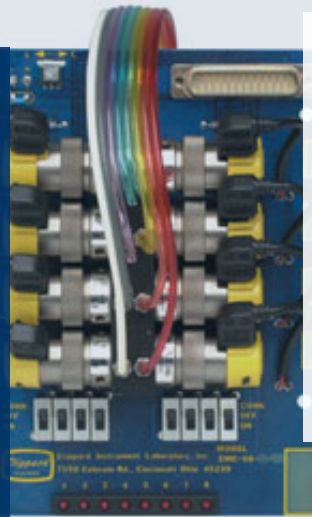**Holophone**

Mixing

Designing

Delivery in constrained settings

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")

Tracking

- **Technologies**
  - **Magnetic**
  - **Optical**
  - **Vision (often with markers/features)**
  - **Acoustical**
  - **Inertial**
- **Hybrid (hardware and soft/hardware)**
- **Calibration**
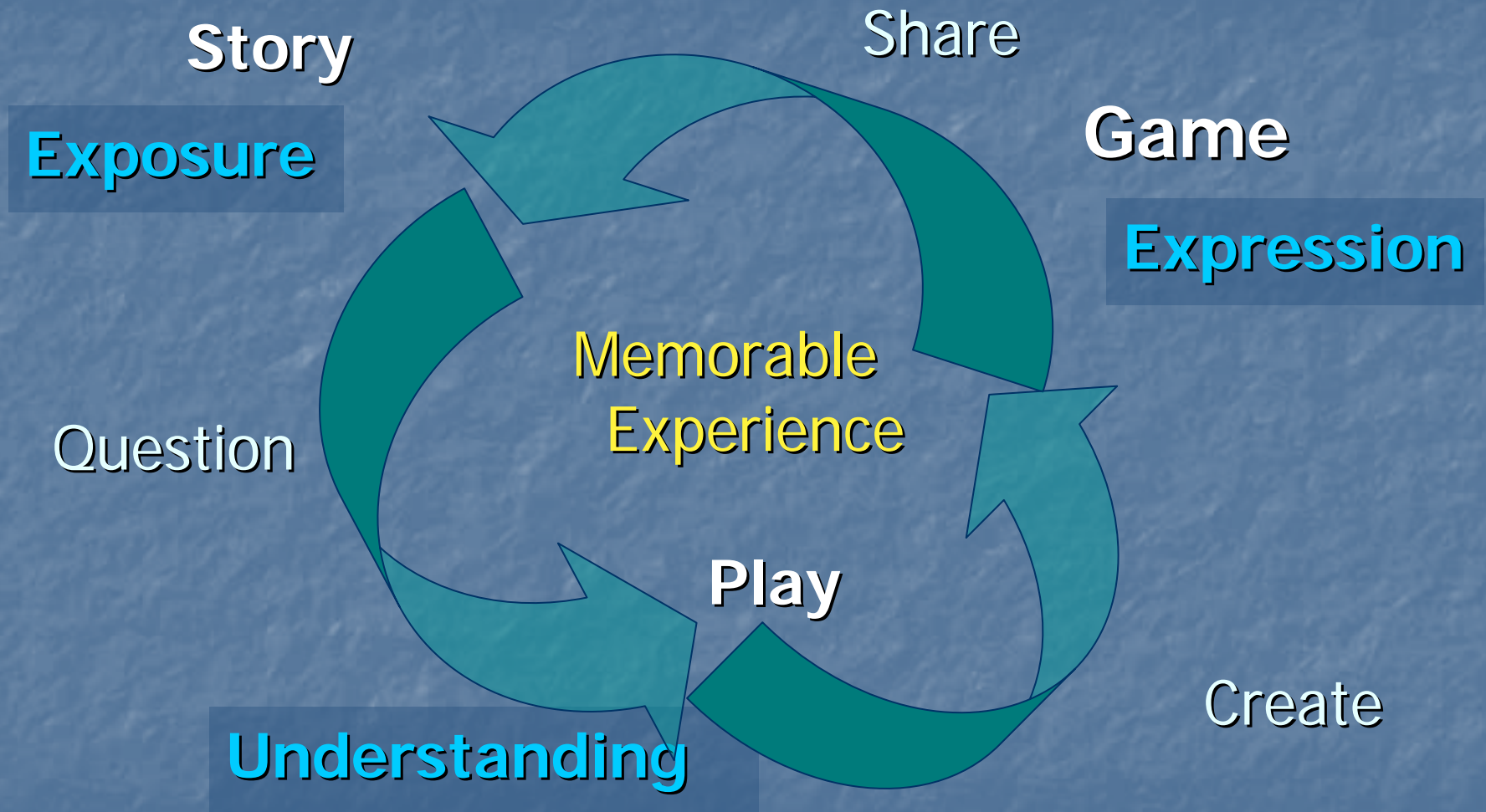
Registration / Illumination

- **Virtual and real must be properly placed relative to each other**

- **Inter-occlusion must be properly managed**

- **Mutual shadowing must occur, including shadows from real caused by virtual light**

- **The effects of ambient light (real and virtual) must be rendered**
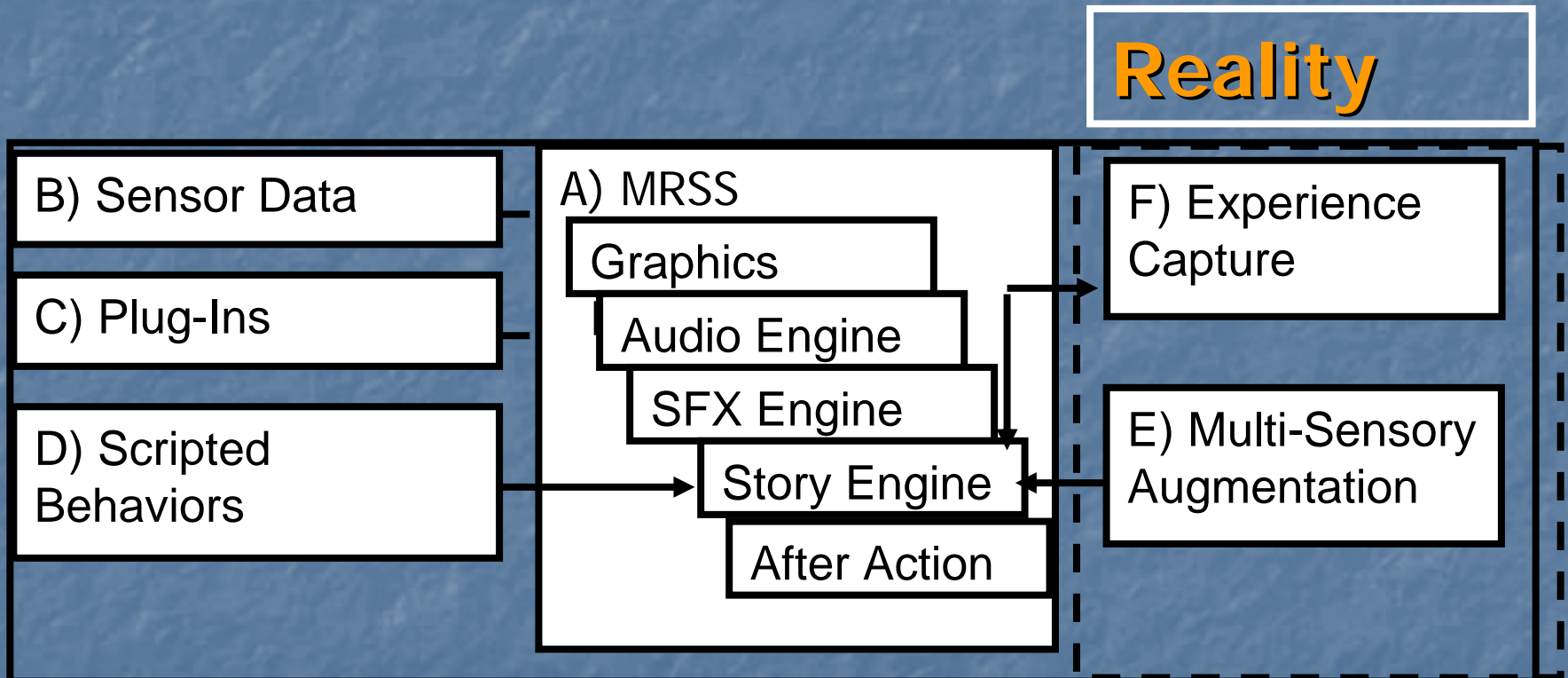
Story

- **Virtual characters must have appropriate behaviors, reactive and proactive**

- **If appropriate, guidance should be provided to user(s) to attract them to overlooked activities / objects**

- **Replay must be provided for entertainment, review, etc.**

Story/Play/Game Convergence

Story

Share

Exposure

Game

Expression

Memorable
Experience

Question

Play

Create

Understanding

MR Software

Reality

| B) Sensor Data |
| C) Plug-Ins |
| D) Scripted Behaviors |

A) MRSS
- Graphics
- Audio Engine
- SFX Engine
- Story Engine
- After Action

| F) Experience Capture |
| E) Multi-Sensory Augmentation |

MR Software Suite

- **Platform neutral**
- **Story Engine**
  - **Agent-based**
  - **Plug-in architecture**
- **Audio Engine**
  - **Constraint-based adaptation (speaker placement)**
- **Graphics Engine**
- **DMX Engine**
- **Experience capture**
  - **After Action Review**
  - **Human Experience Modeler**

An Innovative Interface: The Demo Dome

MS Demo Dome
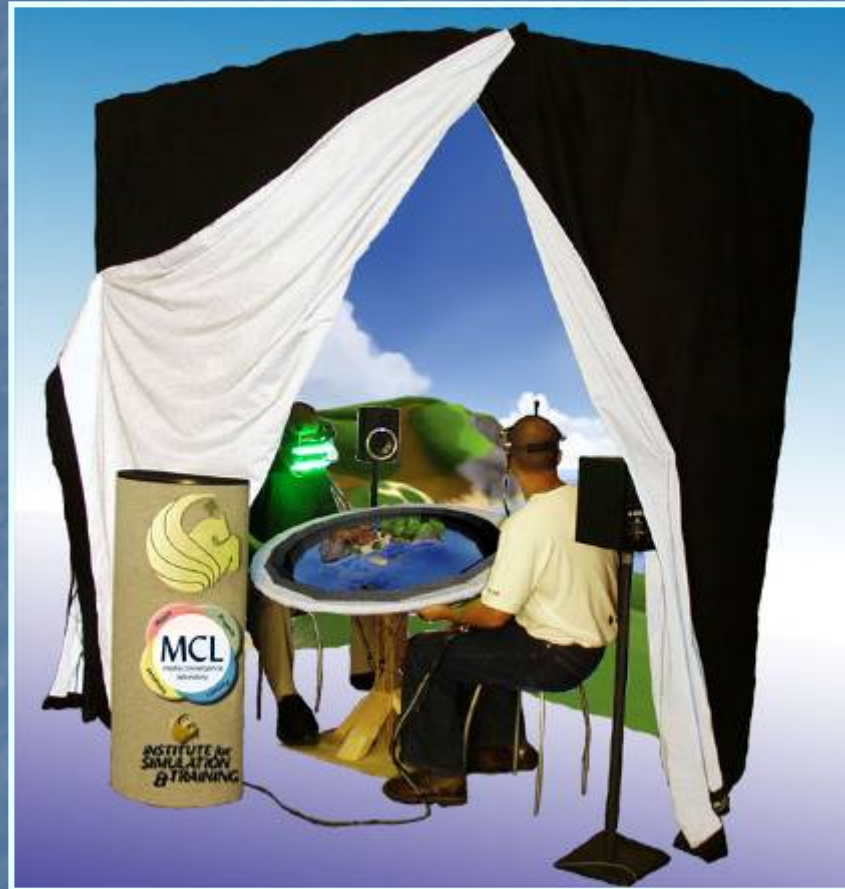
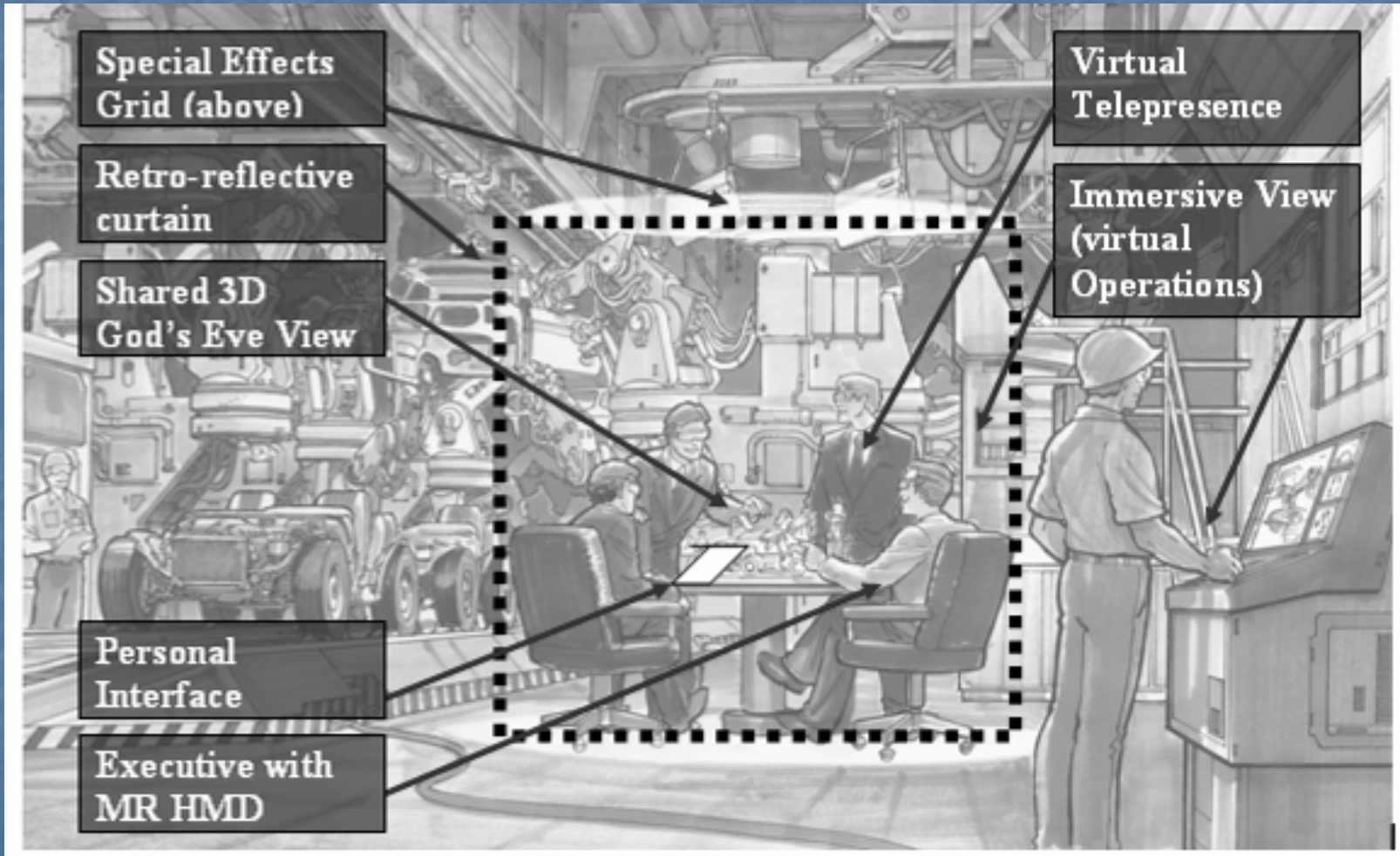**Placing Real Entities into Virtual Environments**

Demo Dome Characteristics

- **Lightweight**
- **Relatively Inexpensive**
- **Tolerant of lighting changes**
- **Distinct POVs**
  - E.g., consider a city planner and an architect
  - Both need a common context (the cityscape)
  - Each wants specialized information (codes vs physical / aesthetic characteristics)

Examples

Peer Collaboration

Special Effects Grid (above)

Retro-reflective curtain

Shared 3D God's Eye View

Personal Interface

Executive with MR HMD

Virtual Telepresence

Immersive View (virtual Operations)

Along the Continuum

- **Start in PR**
  - look at current plant
- **Move to AR**
  - add new equipment and new windows
- **Individuals jump to VR**
  - privately review designs
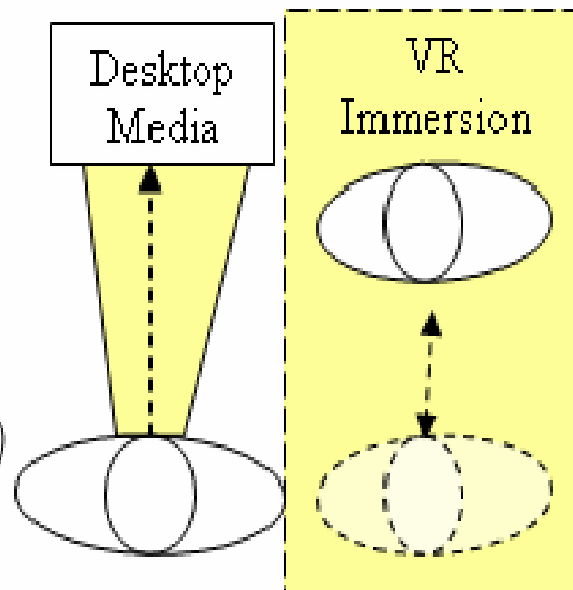- **Move to AV**
  - see each other while surrounded by new design
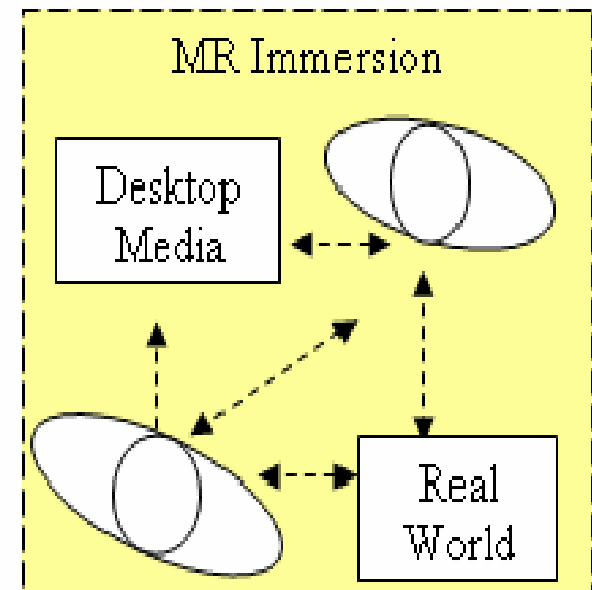
Trainer/Trainee Collaboration
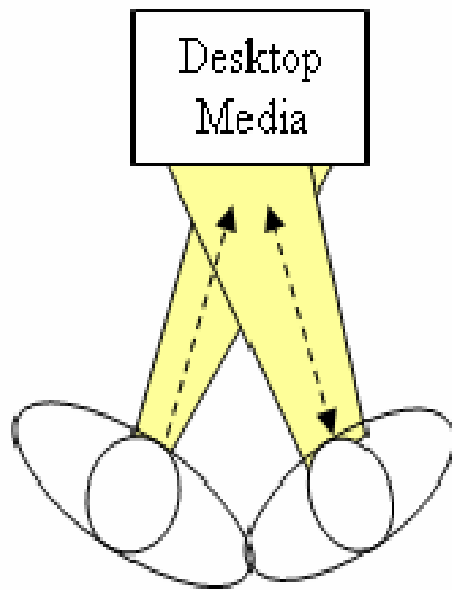
Military Training

MR MINI-MOUT

VR Actors

Vehicular

Sniper

VR Sets

SFX

Hostiles

CGF

HUD

FFW
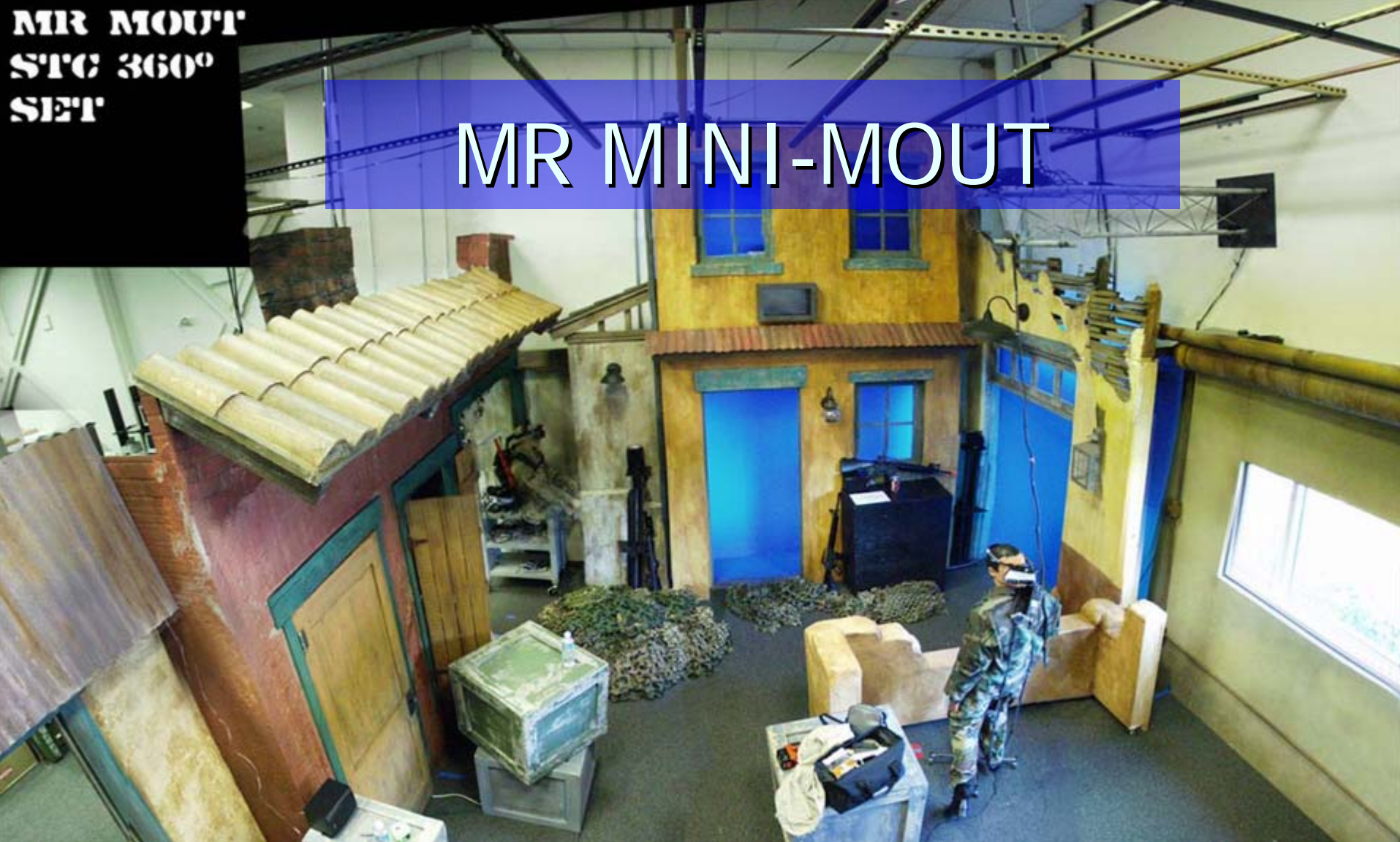
MIXED REALITY

MILITARY OPERATIONS IN URBAN TERRAIN

Multi-Player

MOUT

VR Cues

Merging Realities

Creative Collaboration

Trainer View and Input

- **Multiple POVs**
  - **VR, MR, PR**
- **Auditory commands and cues**
- **Taps on shoulder (haptic vest)**
- **Visual cues**
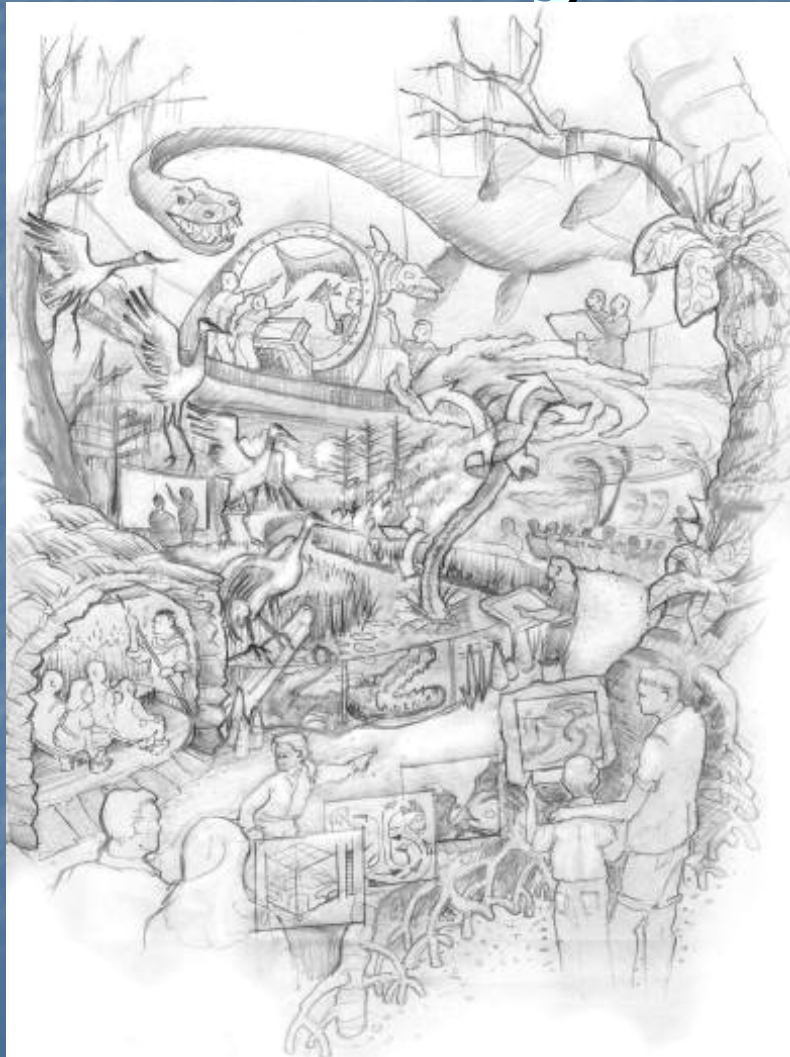- **Visual and direct auditory interaction**
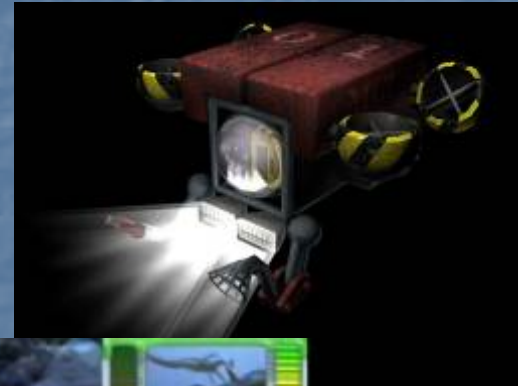- **After action review**

Free Choice Learning

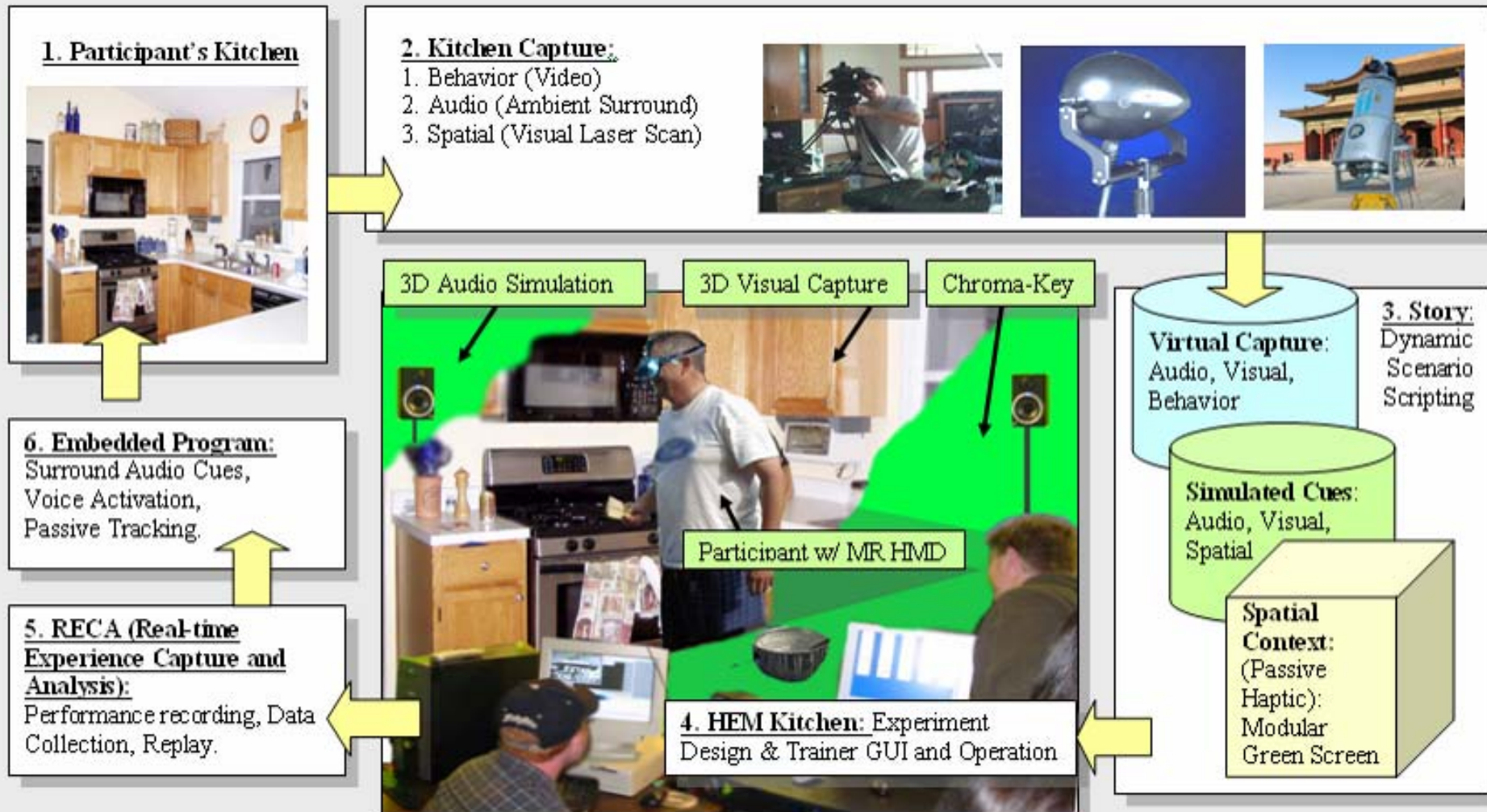# Water's Journey through …

MR Sea Creature @ OSC

MR ROVER

MR Content

Parent / Child Interaction

- **Real**
- **Relevant**
- **Relational**

Human Experience Modeler

1. Participant's Kitchen

2. Kitchen Capture:
1. Behavior (Video)
2. Audio (Ambient Surround)
3. Spatial (Visual Laser Scan)

3D Audio Simulation | 3D Visual Capture | Chroma-Key

Virtual Capture: Audio, Visual, Behavior

3. Story: Dynamic Scenario Scripting

Simulated Cues: Audio, Visual, Spatial

Participant w/ MR HMD

Spatial Context: (Passive Haptic): Modular Green Screen

6. Embedded Program: Surround Audio Cues, Voice Activation, Passive Tracking.

5. RECA (Real-time Experience Capture and Analysis): Performance recording, Data Collection, Replay.

4. HEM Kitchen: Experiment Design & Trainer GUI and Operation

Mixed Reality (MR) Human Experience Modeler (HEM)

SCENARIO	SUBJECT	PERFORMANCE	ENABLING TECHNOLOGY			
	*Live *Avatar *Agent *Robotic *Vehicle *Observer *Command *Trainer *Tutor		DISPLAY	RENDERING	CAPTURE	MONITORING
Script		Time				
Assets		Accuracy	Visual	Visual	Visual	Tracking
Environment		State	Audio	Audio	Audio	Orientation
State (ROE)		Interface	Haptic	Haptic	Haptic	Registration
Procedural		Cognition	Olfactory	Olfactory	Olfactory	Communication
Condition		Collaboration	Gastronomic	Gastronomic	Gastronomic	Data
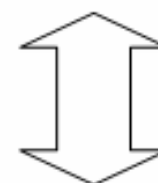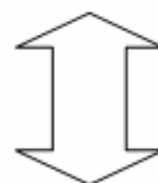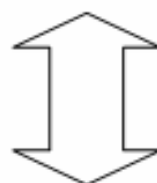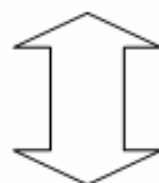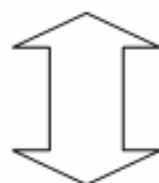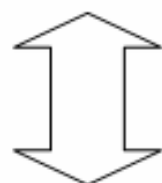
NETWORKING: MIXED REALITY SOFTWARE SYSTEM

SCENARIO SCRIPT AND EXPERIMENTAL ENVIRONMENT: ADAPTATION INTERFACE (Rapid Scenario Development). OBSERVATION, MONITORING AND

PERFORMANCE REVIEW

CAPTURE	ANALYSIS	REPLAY	AGGREGATE	EPISTOLOGY	SYSTEM ADAPTION

Rehabilitation:
Blaine's Breakfast

Rehab Specialist Input

- **Auditory commands and cues**
- **Tap on shoulder (haptic vest)**
- **Visual cues**
- **Visual and direct auditory interaction**
- **After action review**

We wish to thank our partners

University of Central Florida
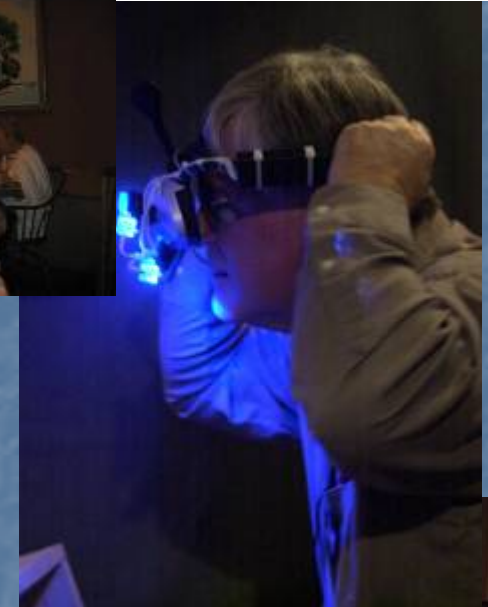
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