Virtual and Augmented Reality

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Outline

- What is VR?
- Types of VR
- VR technologies
  - DIVE
  - VRML
  - QTVR
- VR Issues

Outline

- What is AR?
- Related Concepts
- AR Examples
- Mixed Reality

VR: Defining characteristics

- Computer simulations that use 3D graphics and devices such as the data glove to allow the user to interact with the simulation. (FOLDOC)
- Simulation
- Sense of presence
- Interactivity
  - Direct manipulation
- 3D?

VR: Types of VR

- Immersive
  - Generate representation that surrounds the user
    - VR headsets
    - Data gloves
    - Haptic input devices
    - CAVEs
- Desktop VR
  - Give user "window" onto a 3D world
  - Spatialised sound
  - Haptic input & feedback

VR: VR Hardware Technology

- Head mounted displays
- 3D displays
- Data glove
- Haptic devices
- CAVEs (CAVE Automatic Virtual Environment)

VR: CAVE

- CAVE at UCL
  - Training device for speakers
- Also used to treat phobias

VR: VR Software Technology

- VRML
- QTVR
- DIVE

VR: VRML

- Virtual Reality Modelling Language
- "an open standard for 3D multimedia and shared virtual worlds on the Internet"
- Scene description language
- Requires a viewer
  - Stand-alone
  - Plug-in
- Demo

VR: VRML

- VRML 1.0 – static environments
- VRML 97 (VRML 2.0)
  - Interaction
  - Animation
- X3D
  - Making VRML XML compliant

VR: VRML: A Simple Example

```
#VRML V1.0 ascii

Material{ diffuseColor 1 1 1 }
Sphere        { radius 1 }
Transform{    translation    0 -2.2 0
    rotation 1 0 0  3.14159265
    }
Material{ diffuseColor 1 1 0 }
Cone   { bottomRadius 0.97
         height 4
    }
```

Define a colour (RGB value)

VR: VRML: A Simple Example

```
#VRML V1.0 ascii

Material{ diffuseColor 1 1 1 }
Sphere        { radius 1 }
Transform{    translation    0 -2.2 0
    rotation 1 0 0  3.14159265
    }
Material{ diffuseColor 1 1 0 }
Cone   { bottomRadius 0.97
         height 4
    }
```

Create a primitive shape

VR:
VRML: A Simple Example

```
#VRML V1.0 ascii

Material{ diffuseColor 1 1 1 }
Sphere        { radius 1 }
Transform{    translation     0 -2.2 0
      rotation 1 0 0  3.14159265
      }
Material{ diffuseColor 1 1 0 }
Cone   { bottomRadius 0.97
         height 4
      }
```

move & rotate

VR:
VRML: A Simple Example

```
#VRML V1.0 ascii

Material{ diffuseColor 1 1 1 }
Sphere        { radius 1 }
Transform{    translation     0 -2.2 0
      rotation 1 0 0  3.14159265
      }
Material{ diffuseColor 1 1 0 }
Cone   { bottomRadius 0.97
         height 4
      }
```

Change the colour

VR:
VRML: A Simple Example

```
#VRML V1.0 ascii

Material{ diffuseColor 1 1 1 }
Sphere        { radius 1 }
Transform{    translation     0 -2.2 0
      rotation 1 0 0  3.14159265
      }
Material{ diffuseColor 1 1 0 }
Cone   { bottomRadius 0.97
         height 4
      }
```

Add another primitive shape

VR:
QTVR

- System for generating low-cost simplified pseudo-3D desktop virtual environments
- Based on the QuickTime software architecture
- 3 variants
  - panoramas
  - objects
  - scenes

VR:
DIVE

- Distributed Interactive Virtual Environment
- Provides
  - software infrastructure
  - File formats
  - Applications
- Used for large-scale collaborative virtual reality applications

VR:
VR Issues

- Fatigue & nausea with head-mounted displays
- Computational challenge of achieving fidelity and sufficient performance
- Supporting interactivity
  - Avatars
  - 3D interaction techniques

AR:
Augmented Reality

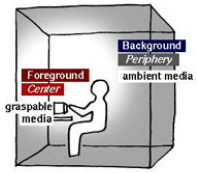
- AR – systems that enhance interaction between a user and his/her physical environment by placing computational capabilities in and around the physical environment

AR:
Related Concepts

- Ubiquitous computing
- Pervasive computing
- Ambient intelligence
- Context-aware systems
- Context-sensitive systems

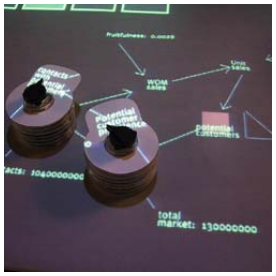
AR:
Tangible Media

- Hiroshi Ishii
- Tangible Media Group, MIT Media Lab
- Adding computation to ordinary physical objects

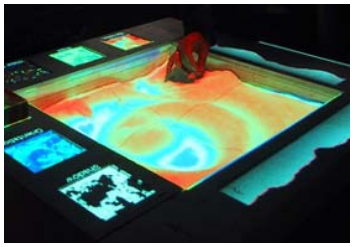


drawing: Hiroshi Ishii

AR:
The SenseTable (MIT Media Lab)

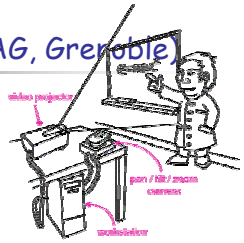


AR:
SandScape (MIT Media Lab)



AR:
Magic Board (IMAG, Grenoble)

- Images can be
  - drawn onto white board
  - Projected onto whiteboard
- Gestures can be detected via processing of video images



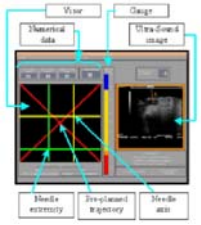
FingerPaint
CHI Group
CLIPS-IMAG

AR:
Agumented Environments

- Life-Sized Projector-Based Dioramas (2001) Kok-Lim Low, Greg Welch, Anselmo Lastra, Henry Fuchs. UNC Chapel Hill

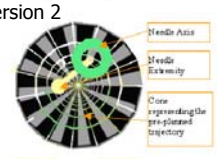
AR:
Case Study: CASPER

Version 1



- Augmented surgery
- Trajectory of needle is planned in advance
- During procedure, position of need is projected onto display

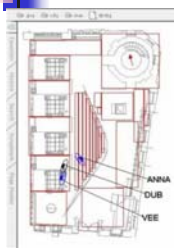
Version 2



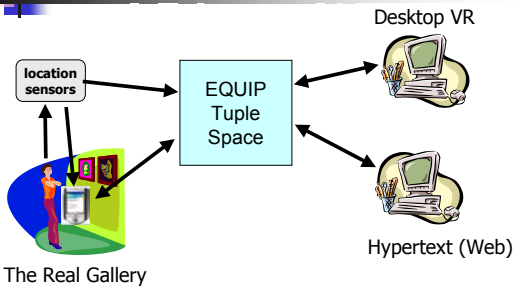
AR:
The Next Step – Mixed Reality

- Mixed reality = VR + AR
- Systems that
  - combine physical and digital information and experience
  - Coordinate physical and digital experiences … for one or more people

AR:
Case Study: The City Project

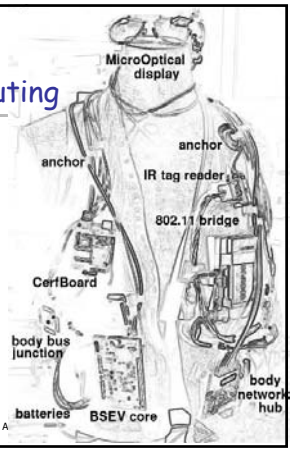


AR:
Case Study: The City Project



AR: Wearable Computing

- computational capabilities are beginning to become available for incorporation in clothes
- MIThril wearable platform



For more information

- CAVEs
  - Mel Slater website
- VRML
  - http://vrmlworks.crispen.org/faq/
- AR
  Hiroshi Ishii, Tangible Media Group, MIT Media Lab
- Pervasive Computing
  - Gregory Abowd, Georgia Tech
- Mixed Reality
  - Equator IRC