Virtual Reality Application

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CAVE Visualization System

• CAVE (CAVE Automatic Virtual Environment): A fully immersive & interactive $10^3$ virtual environment (VE)
• ImmersaDesk: A semi-immersive with a $4' \times 5'$ display

http://www.mechdyne.com
http://www.vrac.iastate.edu
http://www.mechdyne.com
CAVE Components

- **Stereographics:** The projector interleaves images for left & right eyes at a rate of 120 frame/s synchronized with an LCD shutter glass via an infrared emitter; 3D perception is created by showing the two eyes slightly rotated objects.

- **Wand:** A 3D mouse with buttons; the position & angle of the wand as well as button press are user inputs (cf. Wii).

- **Magnetic tracking system:** A sensor is attached to a user’s head so that the scene can be changed according to the user’s position.
CAVE Programming

• CAVE library: A library of C functions & macros to control the operation of the CAVE: keep all the devices synchronized; produce the correct perspective for each wall; & provide the applications with the current state of all the CAVE elements

• Compiling a CAVE application:

```bash
LIBS = -L/usr/local/CAVE/lib32 -lcave_ogl -lGLU -lGL -lXi -lX11 -lm
cc -O -o ball ball.o $(LIBS)
```

• CAVE coordinate system: $10^3$ with the origin at the central floor

http://www.evl.uic.edu/pape/CAVE/prog
#include <cave_ogl.h>
#include <GL/glu.h>

void main(int argc, char **argv) {
    CAVEConfigure(&argc, argv, NULL); CAVEInit(); // Initialize the CAVE
    CAVEInitApplication(init_gl, 0); // Pointer to GL initialization function
    CAVEDisplay(draw_ball, 0); // Pointer to drawing function
    while (!CAVEgetbutton(CAVE_ESCKEY)) sginap(10); // Continue until ESC hit
    CAVEExit();
}

void init_gl(void) {
    float redMaterial[] = { 1, 0, 0, 1 }; // Ambient and diffuse color for the material
    glEnable(GL_LIGHT0);
    glMaterialfv(GL_FRONT_AND_BACK, GL_AMBIENT_AND_DIFFUSE, redMaterial);
    sphereObj = gluNewQuadric();
}

void draw_ball(void) {
    glClearColor(0., 0., 0., 0.);
    glClear(GL_DEPTH_BUFFER_BIT|GL_COLOR_BUFFER_BIT);
    glEnable(GL_LIGHTING);
    glPushMatrix();
    glTranslatef(0.0, 4.0, -4.0);
    gluSphere(sphereObj, 1.0, 8, 8);
    glPopMatrix();
    glDisable(GL_LIGHTING);
}

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**X3D**

- X3D is an open standards XML (extensible markup language)-enabled 3D file format for real-time communication of 3D data across applications over network.
- With X3D browsers and plug-ins, X3D becomes immersive allowing a user to walk through the 3D scene.
- An X3D file is publishable directly on the World Wide Web; an X3D browser acts as a helper application at the client side.

- **X3D homepage**
  [http://www.web3d.org](http://www.web3d.org)

- **X3D plug-ins for Windows, Macintosh, and Linux**
  [http://www.web3d.org/x3d/content/examples/X3dResources.html](http://www.web3d.org/x3d/content/examples/X3dResources.html)
3D in Hollywood

http://www.youtube.com/watch?v=avecKPWqYqM
3D in Science

- **Anaglyph**: Stereoscopic 3D effect by means of encoding each eye’s image using filters of different colors (typically red & cyan).

3D in Molecular Dynamics (1)

K. Nomura et al.,
*Phys. Rev. Lett.*
99, 148303 (’07)
3D in Molecular Dynamics (2)

Y. Chen et al., Appl. Phys. Lett. 93, 171908 (’08)
How to Make Anaglyph Stereo

• In the main window of the VMD software, go to the Display menu, then the Stereo submenu

• Select the Left view & save the image as an image file

• Next select the Right view & save the image as another image file

• Use software such as Photoshop to make an anaglyph by image processing

www.ks.uiuc.edu/Research/vmd/
www.scec.org/geowall/makeanaglyph.html