

Introduction to VRML with Java

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VRML = Virtual Reality Modeling Language
(pronounced like “Sqirmmel” ;^)

Agenda

- n The New Web Paradigm.
- n The Dawn of Cyberspace :^).
- n Development of VRML 1.0 and 2.0.
- n VRML Present and Future and Java 3D Overview.
- n Building a VRML World -- VRML Nodes and File Format.
- n Animation Methods / Visualization Demonstrations:
 - u VRML Interpolator Node -- motion without Java.
 - u VRML Script Node -- motion with Java.
 - u SGI's External Authoring Interface (EAI) for Java.
 - u Using Gnu's Java JVerge wrappers for EAI.
- n Compatibility Issues and Lessons Learned.
- n Key VRML / Java URL's / Books.
- n Some Cool VRML Sites B^).

The New Web Paradigm

- n Old Web paradigm -- 2D Static paper-like documents.
- n New Web -- experiential, interactive, immersive -- more like real life.
- n We are hard wired for 3D:
 - u Highest bandwidth input into the brain.
 - u We naturally organize information of the “world database) spatially and use shape info, color etc..
- n Integration of all media into 1 environment!
 - u 3 Dimensional sound.
 - u Movie textures.
 - u Viewpoint collision detection.

The Dawn of Cyberspace --VRML History (all 3 years ;^)

- n 1991 Tim Berners-Lee launches The World Wide Web, Neil Stephenson publishes *Snow Crash* (not unlike William Gibson's *Neuromancer* of 1984).
- n SGI's Open Inventor gave an object-oriented graphics file format.
- n Fusion of sci-fi concepts, virtual reality, and the WWW yielded VRML 1.0 spec. in Oct. 1994.

VRML 1.0 and the VRML Architecture Group

- n VRML Architecture Group (VAG) formed to discuss / design the future of VRML.
- n The VAG is an *OPEN* group -- not controlled by any 1 vendor, with discussion via the Internet.
- n VAG addressed the weak points of VRML 1.0:
 - u Static -- fixed worlds without animation.
 - u No real user interaction.
 - u 3D graphics only -- no other media.

Emergence of VRML 2.0

- n To address weaknesses of VRML 1.0, in 1996 proposals for VRML 2.0 were submitted by: Sun (HoloWeb), Microsoft (ActiveVRML), Apple (Out of This World), SGI (Moving Worlds) and others.
- n Moving Worlds took 70% of the VAG vote and became the basis of VRML 2.0 with the spec published at SIGGRAPH 1996.

VRML Present and Future -- VRML '97

- n VAG handed off to the VRML Consortium in Dec. 1996.
- n VRML Consortium (collection of industry) has generated the “VRML '97 Draft International Standard” which has been submitted to ISO.
 - u Minor changes from VRML 2.0.
 - u Working groups of VRML Consortium still open to anyone.
- n Final VRML '97 Standard coming in Dec. 1997 (but then it'll soon be 1998 ;^).

Current Browser Situation

n Industry Consolidation.

u SGI:

- F Acquired ParaGraph (maker of good VRML modelers).
- F Made a deal with Netscape to merge CosmoPlayer (browser made by CosmoSoftware SGI spinoff) with Netscapes Live3D into the monster, Netscape Communicator.

u Microsoft:

- F Acquired DimensionX (makers of Liquid Reality).
- F Made a deal with Intervista to ship the WorldView browser with Internet Explorer.

n Other players Black Sun Interactive (Passport) and Sony (Community Place).

n CosmoPlayer (soon with Mac support ?!) preeminent.

Java3D Overview

- n Partner companies: SGI, Intel, Apple, Sun.
- n Part of JavaMedia suite of API's -- run anywhere, display anywhere over the net.
- n Has both high level scene graph (like Open Inventor) and low level (like OpenGL) graphics and rendering constructs.
- n Includes 3D spatial sound.
- n Layered optimization for high performance:
 - u Support for native API's: Direct3D, OpenGL, and Quickdraw3D.

Java3D Overview (Cont'd)

- n Java3D has a new human-centric view model:
 - u Separates virtual and physical world.
 - u Permits any display device including head trackers.
 - u Seamless generation of stereo views.
- n Java3D allows VRML 1.0 and 2.0 files (and others) to be loaded and will support 2.0 behaviors/scripts through a runtime utility:
 - u Details on the utility will be fleshed out in a future Java3D spec.

Building a VRML World -- Basic VRML Nodes

- n The scene graph -- contains nodes (building blocks of a scene) which contain fields or attributes.
- n Grouping nodes -- group, transform, switch
- n geometry nodes -- sphere, cone, cylinder, box.
- n Appearance node contains material, texture.
- n Other nodes -- lights, sounds, viewpoints, LOD, anchor, inline... many more...

Structure of a VRML File--“Hello Cyberspace”

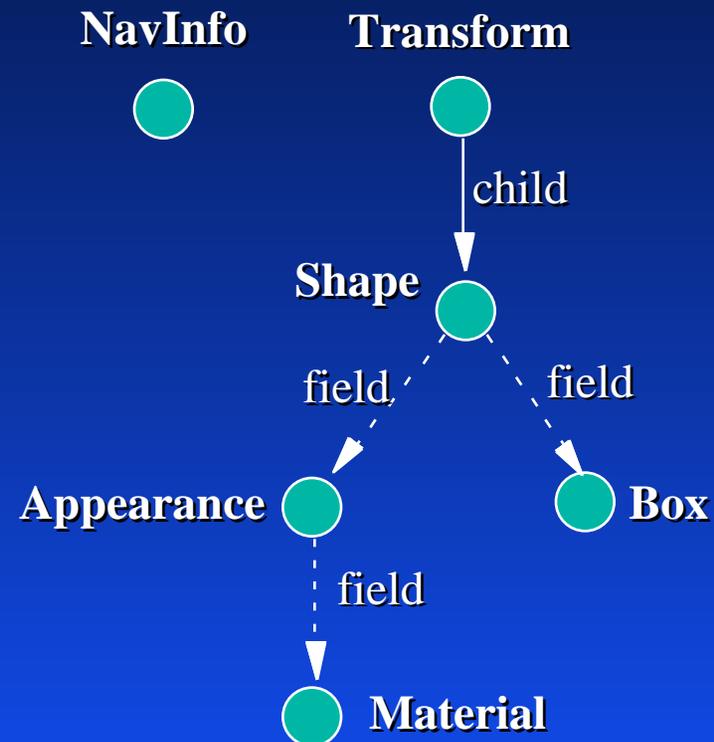
```
#VRML V2.0 utf8 # required header
```

```
NavigationInfo # global nodes  
{  
  type EXAMINE  
}
```

```
Transform # scene hierarchy  
{  
  children  
  [  
    Shape  
    {  
      geometry Box  
      {  
        size 3.5 3.5 3.5  
      }  
      appearance Appearance  
      {  
        material Material  
        {  
          diffuseColor 1 0 0  
        }  
      }  
    }  
  ]  
}
```

```
# put scripts and event routing at the end
```

Graphically:

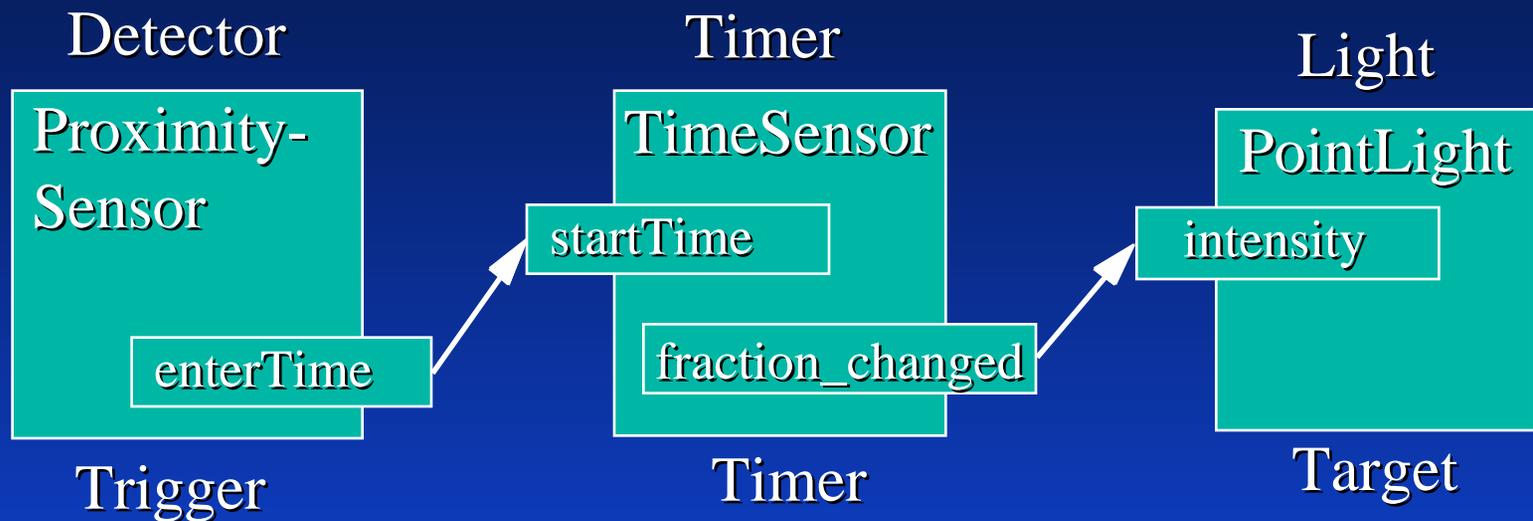


Animation -- Methods of Motion

- n Sensors:
 - u Drag -- plane, cylinder, sphere.
 - u Time, touch, proximity.
- n Events -- Route eventOut to eventIn.
- n Engines:
 - u Interpolator nodes -- position, orientation, scalar...
 - u Script node -- Java, JavaScript, VrmIScript...
- n External manipulation of VRML via Java:
 - u EAI.
 - u JVerge.



Sensors and Events



VRML Interpolator Node

- n Interpolator nodes (linear) are used to do key frame animation with key / value pairs:
 - u PositionInterpolator -- move an object through predefined positions.
 - u OrientationInterpolator -- rotate an object.
 - u ColorInterpolator -- cycle through colors.
 - u CoordinateInterpolator -- morph through different shapes.
- n Can simulate non-linear interpolation by spacing keyframe values together/apart.
- n Can “multicast” from one Interpolator node to different targets.

VRML Script Node

- n Java Script Authoring Interface (JSAI) -- slower to execute than interpolators but capable of full procedural effects.
- n Act as engine to control animation or as logic stage to process input.
- n Manipulate the scene graph, do network calls, using the Browser API (JSAI?), but better to use EAI.
- n Supported scripting languages depend on the browser -- Java, JavaScript, VrmlScript most common.

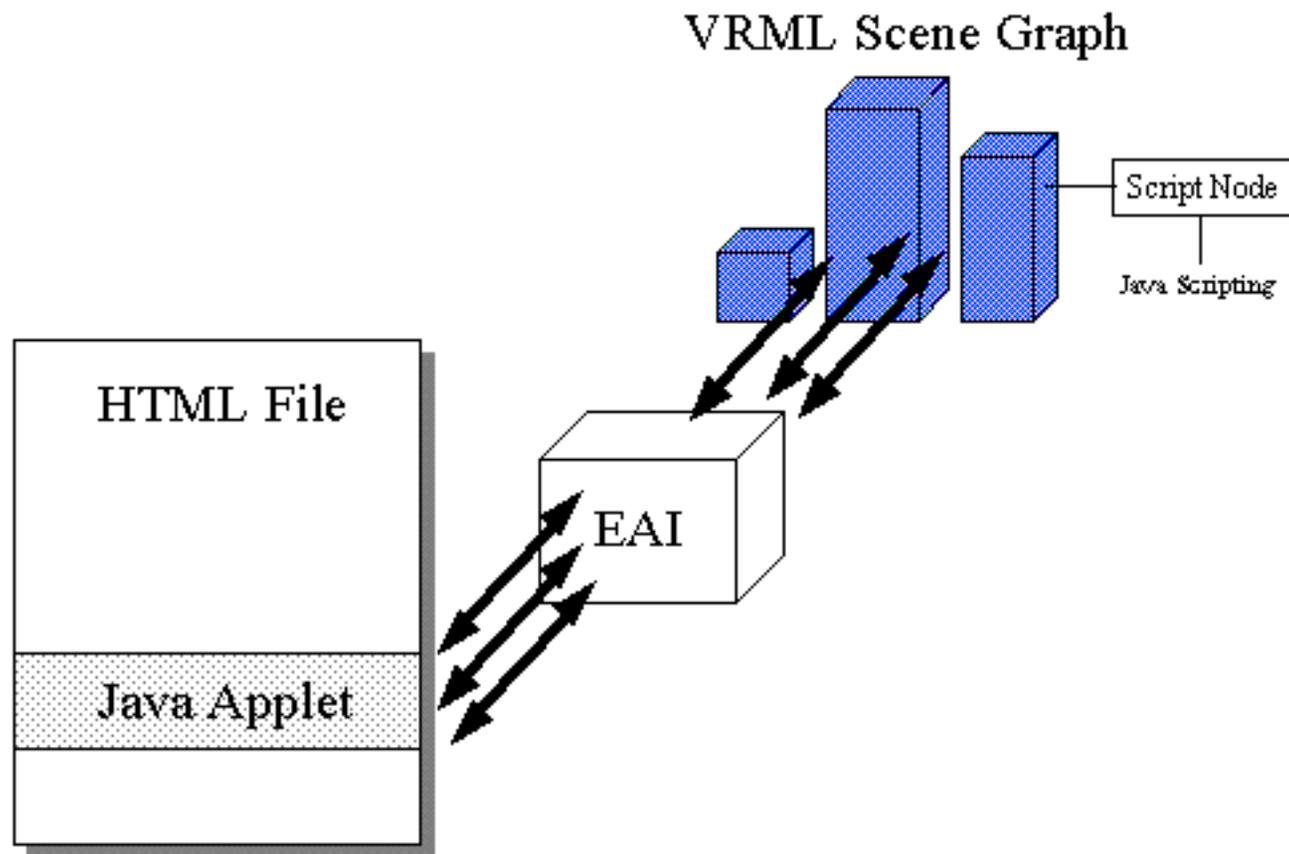
SGI's External Authoring Interface (EAI)

- n EAI is currently an “Informative Annex” to the VRML 2.0 standard>
- n Allows a Java applet to establish a 2-way link to a VRML world giving full procedural control over the scene.
- n The External Authoring Interface allows 4 types of access into the VRML scene:
 1. Accessing the functionality of the Browser Script Interface.
 2. Sending events to eventIns of nodes inside the scene.
 3. Reading the last value sent from eventOuts of nodes inside the scene.
 4. Getting notified when events are sent from eventOuts of nodes inside the scene.

GNU JVerge (by Justin Couch)

- n Complete implementation of all VRML 2.0 nodes as java classes (version 0.7 beta 3).
- n Independent of VRML-Java API environment (EAI is wrapped).
- n Enforced correctness of VRML through java class mechanisms (no worries about parameters).
- n Entire scenegraph output to any streamable source.
- n Automatic DEF/USE capabilities.

EAI Architecture Diagram



Browser Compatibility / Issues

- n CosmoPlayer only supports VrmlScript right now on SGI.
- n There is Java support on the beta3a release for Windows.
- n But Text nodes not supported on beta3a -- therefore can use Netscape Communicator (which integrates CosmoPlayer) but it's still crash-prone.
- n Other issues:
 - u Various nodes not implemented.
 - u Textures and sounds increase download times.
 - u Too much animation will degrade performance.

EAI Lessons Learned

- n Put Java EAI functionality in start or run method of applet so it is reconnected when you reload the page.
- n Use the static method `Browser.getBrowser(Applet)` to get a handle to the browser.
- n Be sure that eventOut objects don't go out of scope or you will lose events.

Key URL's -- VRML and Java3D

n SGI:

- u <http://vrml.sgi.com> <-- BIG VRML site:
 - F Tutorials
 - F Worlds -- Floops -- cartoon : ^)
 - F Articles, developer info

n The VRML Repository:

- u <http://www.vrml.ch/>
 - F Browser/plugin info
 - F Doc's
 - F Worlds, utilities, lots more...

n Java3D:

- u <http://www.javasoft.com/products/java-media/3D/>

More VRML URL's

- n <http://hiwaay.net/~crispen/vrml/intro.html>:
 - u Getting started in VRML, browsers, world building, etc..
 - u History.
 - u FAQ.
- n VRMLSite online magazine:
 - u <http://www.vrmlsite.com/>
- n FREE! online VRML'97 Annotated Reference Manual:
 - u <http://www.best.com/~rikk/Book/book.shtml>.

Key URL's -- Cosmo / EAI / JVerge

n CosmoPlayer:

- u <http://cosmo.sgi.com/player>
- u <http://cosmo.sgi.com/player/relnotes/>
- u <http://cosmo.sgi.com/player/developer/>

n EAI:

- u <http://www.graphcomp.com/vrml/java/gcPoser/>
- u <http://cosmo.sgi.com/player/developer/eai/>

n JVerge mirror sites:

- u <http://www.vlc.com.au/JVerge/mirrors.html>

n VET VRML / Java Demo site:

- u <http://www.cen.com/non-century/ASTES/VET/vrml/vrml.html>

Books

- n Most up to date information is on the WEB of course -- technology is evolving very fast.
- n *The Annotated VRML97 Reference Manual:*
 - u Most up to date.
 - u By THE authorities on VRML.
- n *The VRML 2.0 Handbook:*
 - u Solid tutorial for beginners (by SGI folks).
- n *Java for 3D and VRML Worlds:*
 - u Advanced book covers script node (no EAI) almost a year old (becoming ancient fast;).

Authoring Tools and Utilities

- n Cosmo Worlds.
- n ParaGraphs's Virtual Home Space Builder (recently acquired by SGI), many others... surf to find 'em.
- n vrmllint -- only for 1.0 right now
- n Translators: ivToVRML, Quake To VRML, DOOM To VRML2 ;^).

Some Cool VRML Worlds B^)

n Tenochtitlan:

u <http://vrml.sgi.com/handbook>

n Mars Pathfinder mirrors:

u <http://mars.sgi.com>

n Floops:

u <http://vrml.sgi.com/floops>

n Proteinman's Top 10 VRML Worlds:

u <http://www.clark.net/theme/proteinman>