Web3D Quickstart 1

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The Greatest Common Denominator

1997 era VRML worlds runs in:

- 2018 HyperCube ....
- Samsung GearVR, DayDream Apps
- HTML5
- ...

21 years of asset durability

And reproducibility !!!
VT Visionarium Lab Upgrade

- 26.7 million active stereo pixels: *The HyperCube CAVE*
- Intersense, now ARTracking
- Active -> Passive -> now Active stereo
Something in Common?

Vis.arc.vt.edu

Instantreality.org

3dprint.nih.gov
Web3D.org

Specifications, Resources, Community

VRML -> Web3D Conference Proceedings

- 23 Years in the ACM Digital Library

Google Scholar search:

- ‘Extensible 3D’ 109,000 hits; 19,500 hits for ‘X3D’
- ‘Virtual Reality Modelling Language’ 258,000 hits; 80,300 hits for ‘VRML’
VRML is X3D...

A text editor:

Change the first line of your *.wrl from:

```
#VRML V2.0
```

To:

```
#VRML V3.0
```

... save as *.x3dv

*but X3D is so much more!*
YouTube
Web3D Consortium Channel
https://www.youtube.com/user/Web3DMaster/playlists

Twitter
https://twitter.com/Web3DConsortium
Standards make the Web go round!

Runtime approaches:

1) Installed engines import, export render X3D and VRML with different node Profiles

2) Javascript Polyfills ('native' in browser):

- X3DOM: https://www.x3dom.org/
- X_Cite: http://create3000.de/x_ite/
X3D Engines  (March 2018)

- Instant Reality
- Covise/OpenCover
- GearVR
- Castle3D
- FreeWRL
- H3D (Haptics, py)
- Coin3D
- Titania
- Octaga
- Xj3D
- BS Contact
- ...

**HTML5 + WebGL Javascript Polyfills:**

- X3DOM
- X_CITE
- NIH 3D Viewer
- Smithsonian X 3D
  ...

  Three.js

  ...

  ...
Instant Reality

http://www.instantreality.org/
Covise/OpenCover

https://github.com/hlrs-vis/covise
X_CITE and LINUX X3D Editor

TITANIA

http://create3000.de/
Castle3D Game Engine

https://castle-engine.io/
FreeWRL

http://freewrl.sourceforge.net/
H3D.org - Haptics

X3D + Volume Component (MEDX3D)
4D: a first-class citizen

- Networked 3D digital assets
  - Objects and components
  - Appearances & materials
  - Environments
- Animation and Timeseries databases
- Metadata & web-aware referencing
- Interaction semantics
X3D Scene graph

Resources & International Community

www.web3d.org


Book:

http://x3dgraphics.com/

Online Slides: http://x3dgraphics.com/slidesets/index.php

Online Examples: http://www.web3d.org/x3d/content/#Examples
ISO-IEC Standard Scope

Scene graph for real-time interactive delivery of virtual environments over the web:

• Meshes, lights, materials, textures, shaders
• Integrated video, audio
• Animation
• Interaction
• Behaviors
• Scripts
• Application Programming Interfaces

3.3 examples for Medical Imaging, CAD and Geospatial support!
X3D & VRML Scene Graph

- Transformation
  - Directed Acyclic Graph
- Worlds by URL#Viewpoint
- Bind-ables
  - NavigationInfo {}
    - modes: WALK, FLY, EXAMINE, ...
  - Default to lexical order
  - Modifiable through Script and SAI / EAI
  - Background, Fog,
  - Viewpoint
Foundations

- ISO standard, openly published and royalty-free
- A layer above media and rendering libraries
- Multiple implementations including open source codebases
- X3D Scene graph includes the *Transformation graph* and the *Behavior graph*
Scene Graph

● Lives above the rendering library
● Specifies object and environmental properties:
  – Lights
  – Camera
  – Transformation and Grouping of Shapes (parent - child)
  – Geometry and Appearance (materials, textures, shaders)
  – Environmental effects (e.g. Fog, Backgrounds)
● Manifests animation and interaction behaviors
● Is 'traversed' for drawing
Scenegraph

Lots of tools export:

- Virtual Reality Modeling Language (VRML)
- Extensible 3D (X3D)

... lots of other proprietary formats; can be converted with commercial translation tools, open source tools, or your own Scripts!

Target X3D Profiles and Components for different node sets (functionality)
Behavior Graph

- How events flow through the system
  - ROUTEs
- The 'Event Cascade' per timestep / frame
  - Animations (keyframe)
    - Interpolators
    - Sequencers
    - Timesensor
  - Interactions
    - ROUTE sensors to Event Utilities
    - Or write a Script {} to process events w logic
Lights

- Have attributes:
  - position, orientation/direction, on/off, intensity, color, range, attenuation, ...
- DirectionalLight
- PointLight
- Spotlight
- Scoping rules
  - Siblings
  - global
Cameras

- Binding Stack
  - Current at top
  - Forward and Back in the Stack (Pg-Up, Pg-Dn)
  - Listed in Browser
  - Scripted

- Viewpoint: perspective camera
- OrthoViewpoint: orthographic camera
Transformation & Grouping

- Transform
- Group
- LOD
- Switch
- Billboard
- Collision
- Anchor

Scenegraph scopes lights and sensors
Shapes

Consist of geometry and appearance data:

- Material, ImageTexture, Shaders
- Primitives (Box, Cone, Cylinder, Sphere)
- ElevationGrid, Extrusion
- IndexedFaceSet, IndexedLineSet
- PointSet
- Carries Color, Normals, Coordinate, indices
- ‘ComposedGeometry’ component includes triangle fans and strips
Environment nodes

Bindables:

- BackGround
- TextureBackground
- Fog
- LocalFog
Animation

- Keyframe or Scripts
- Keyframes:
  - InterplatorS
  - SequencersS

**For each field type you want to animate:** position, orientation, scalar, integer, color, coordinate

ROUTE TimeSensor.fractionChanged to *Interpolator key

ROUTE *Interpolator keyValue to node’s field
Going Immersive @ VT

Instant Player Engine files:

- Stereo Windows and Screens
- 3DUI as Javascript

InstantIO components:

- ART head, wand data
- DTK/TrackD (Intersense)
- Navigator
Data Structures for Computer Graphics

- Raster Images are generated …
- Vector graphics
- None – pure OpenGL drawing
- Scene Graph:
  - Transformation Graph
  - Behavior Graph
- DOM and styling
Scene Graphs

- Declarative
  - Rich:
    - Inventor, VRML, X3D, COLLADA, ...
  - Simple
    - Gltf, glb
- Imperative
  - Built / modified programmatically (by API)