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X3D Quick Start: Ecosystem

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X3D Tutorial Outline

Technology Overview

Ecosystem

Break

Applications: VT, Navy, NIH, 3DMD, ...

Authoring
X3D Approach

- Re-use and compose interactive 3D models and scenes
- Maximize the functionality of the System layer
- Minimized the complexity of the Application layer
- Provide API hooks for alternative devices: eg displays and user interfaces
Industry Standards unify communities
Take-Aways

● X3D and open standards leadership helps Virginia Tech fulfill its mission everyday
● X3D supports interoperable data, unlocking value across the enterprise, application stovepipes, and hardware platforms
● X3D is durable, providing a data strategy longer than silicon valley life-cycles
VirtuWorlds Giza (1998-2020)

Early searches into 3D and Virtual Reality:

- Epistemology
- Metaphysics
- The Web
- Archival 3D
Access: VT Visionarium

Immersive Visualization

27 mil stereo pixels!
Access: WebVR

- X3D and HTML5 files
- Uses the browser as the platform
- Many headsets
Access: WWW and VR

- X3D: desktop, mobile, immersive VR/MR/AR
- Imaging
  - X3D Volume Rendering
  - TIFF stacks, DICOM, NRRD, PNG
  - Scripted automated conversions
- Molecular Visualization
- Immune Simulation
- Genomic alignment
- Polygons and volumes living together
- VR and 3D printing !!!
VT Visionarium Lab Videos

- [https://www.youtube.com/user/VTVisionarium](https://www.youtube.com/user/VTVisionarium)

See also:
- [Projects & Gallery](#)
X3D Unified Object Model

Lets us auto-generate

Valid Encodings and bindings

From the abstract spec IDL!
Standards make the Web go round: Ecosystem of Engines

*Runtime approaches:*

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

2) Javascript Polyfills ('native' in browser):
   - X3DOM: [https://www.x3dom.org/](https://www.x3dom.org/)
   - X_ite: [http://create3000.de/x_ite/](http://create3000.de/x_ite/)
**X3D Engines** (installed)  
(March 2020)

- Instant Reality
- Covise/OpenCover
- V-slam.org (Unity, Hololense)
- Castle3D
- FreeWRL
- H3D (Haptics, py)
- Octaga
- Xj3D
- BS Contact
- Coin3D
- ...

**HTML5 + WebGL Javascript Polyfills:**

- X3DOM
- X_ITE
- NIH 3D Viewer

...
Instant Reality

http://www.instantreality.org/

Free (w/ Logo) ; includes aopt
Going Immersive @ VT

Instant Player Engine files:
- Stereo Windows and Screens
- 3DUI as Javascript

InstantIO components:
- ART head, wand data
- DTK/TrackD (Intersense)
- Navigator
Immersive X3D Examples

A variety of implementation efforts:

- Hololense, Vive with V-Slam
- WebVR: Oculus, Cardboard
- Multi-projector CAVEs (same X3D file)
- Samsung GearVR, Google Pixel
- VR Hackathons
Covise/OpenCover

https://www.hlrs.de/covise/support/

https://github.com/hlrs-vis/covise

Open Source!
v-Slam

https://www.v-slam.org/

Open Source!

Built w Unity

Server-side

Collab
Castle3D Game Engine

https://castle-engine.io/  Open Source!

View3DScene supports

Model conversion including

FBX, OBJ, X3D, VRML
FreeWRL

http://freewrl.sourceforge.net/

Open Source!
H3D.org - Haptics

X3D + Volume Component (MEDX3D)

Open Source!

Download the latest H3DAPI here!

H3D API 2.3.0, the latest of H3D API versions, is released on 13th June 2014 and can be downloaded here! Haptics programming has never been easier.

New features in H3D API 2.3.0:
- Performance improvements for graphics rendering and start up time.
- Quite a lot of new functions accessible from Python.
- Many new nodes such as GaussianFilterShade, GeometryGroup, PlaybackDevice, NoiseTexture and RazerHydraSensor.

See changelog for changes in H3D API 2.3.0

Download the latest H3DViewer here!

The latest version of H3DViewer, which is our X3D browser can be obtained through the links below.

- Windows 32 bit
- Windows 64 bit
- OSX 10.6.8
Other Notables

Xj3D - Open Source X3D & VRML Browser (Java)  [https://sourceforge.net/projects/xj3d/](https://sourceforge.net/projects/xj3d/)

Coin3D - Open Source C++ for Inventor, Supports VRML and X3D  [https://github.com/coin3d](https://github.com/coin3d)

OctagaVS -  [https://www.octagavs.com/](https://www.octagavs.com/)  X3D & VRML free (w / Logo)

GearVR - X3D content; X3D store opened China for Samsung
JavaScript ‘Shims’

*HTML5 + WebGL*

**Javascript Polyfills who know X3D:**

- X3DOM
- X_ITE
- NIH 3D Viewer
- NB: there are basic loaders for three.js: built-in VRML and X3D by JSON
X3DOM.org

- Integrates 3D content seamlessly into your webpage
- Access & manipulate Nodes per DOM-API
- No Plugins needed
- Simply include a javascript file
- Open-Source
- Free for non-commercial and commercial purposes
- WebVR
See Examples

https://www.x3dom.org/examples/

https://examples.x3dom.org/gltf2/
Visit!

Install one or more X3D Engines!

Check the URLs of these HTML5 runtimes!
Extensible 3D (X3D)

- Components and Profiles collect a structured nodeset (scene graphs)
  - Geometry, appearance, lighting
  - Animation, multimedia (sound, video)
  - Interaction and application logic
- File format with multiple encodings: XML, UTF8, Binary, JSON
- Runtime API for a Unified Object Model with multiple programming language bindings (JavaScript, Java, C#, C++, Python, ...)
- Widespread support through multiple commercial and open-source engines and VRML heritage
- ISO-IEC Standard
Playing Well on the Web

No space in file names!

X3D 4.0 will support GLTF and PBR

https://www.web3d.org/blog-integrating-x3d-and-gltf
X3D Metadata

Travels with the 3D information and can be granular at any node when embedded in the scene graph. Scenes can be composed through the Inline node.

- UNITS & measures defined per scene
- **Metadata can be on any node in the scene**
  - Provenance and source of data
  - Document processing tool chains for derived data
  - Community vocabularies and annotations (FMA, SNOMED, CT, ...)
  - W3C encryption and authentication by element
Semantics + X3D

X3D Ontology for Semantic Web site
https://www.web3d.org/x3d/content/semantics/semantics.html

What could we do with semantics for 3D contents? (the SemWeb-expert way)

- A semantic description of a 3D scene is an expression that can answer to semantic reasoning and queries about the scene.

- Reasoning and queries may cover geometrical, structural, presentational and behavioral properties of 3D objects at the 3D-specific and domain-specific levels of abstraction.
  - Structural, e.g.,
    - How many polygons does a 3D model have? (3D-specific)
    - What are components of a virtual car? (domain-specific)
  - Presentational, e.g.,
    - Which objects in a scene use a common texture? (3D-specific)
    - Which objects in a scene are made of wood? (domain-specific)
  - Behavioral, e.g.,
    - What scripts describe the behavior of an object? (3D-specific)
    - What is the exercise performed by an avatar? (domain-specific)

- Different 3D- and domain-specific ontologies could be used together to describe 3D content, in particular through mapping, e.g., a virtual museum ontology mapped to a 3D ontology.
Tutorials from Software

Have some helpful fundamentals about the X3D scene graph

X3DOM Tutorials:  https://doc.x3dom.org/tutorials/index.html

X_ITE Tutorials:  http://create3000.de/users-guide/tutorials/

NB: developing and testing HTML5 X3D locally usually needs a localhost server running (e.g. atom editor extension; python -m SimpleHTTPServer &)

Ecosystem of Authoring

Text editors, structured editors (eg any XML-tool, X3D Edit)

Free & Open Source: Titania, Blender, MeshLab

Free: Vivaty Studio
Producing X3D content

- Exporters (MatLab, Paraview, VMD…)
- Authoring Tools (Blender, Modo, 3DSMax, …)
- Converters (PolyTrans, CADExchanger, FME,…)
- Scripts to produce X3D documents and pages
- Text Editors to produce X3D documents and pages
- Runtime programs to feed X3D engines
Tons of Tools…

- Blender
- MeshLab
- 3DS Max
- Modo
- Rhino
- Maya
- Paraview
- Agisoft
- ARCSpace
- Creoform
- PointFuze
- ...

export me!

- Titania (Linux)
  - http://create3000.de/
- X3D-Edit
  - https://savage.nps.edu/X3D-Edit/
- AOPT (w/ InstantPlayer)
- View3D Scene
- XML & stylesheets
- ...

- 3DPrint Exchange
- POSTGIS
  - https://postgis.net/
- ...
- Okino Polytrans
- Safe Software
- ...
- ...
Notes

Most work out of the box, but

Sometimes post-processing w/ a script or hand-editing will be necessary:

- To add metadata
- To change a url
- To fix an exporter bug
- ...

NB: Be vocal on mailing lists and support sites!
Blender

Blender includes support for X3D out-of-the-box.

2.7 was decent; 2.8 broke a lot of things; 2.82 restores basic functions

CastleGameEngine support another path for getting animation data from Blender to X3D:

https://castle-engine.io/creating_data_blender.php#section_castle_anim_frames
3DS Max

Has built-in VRML exporter

The HLRS / U Stuttgart exporter supports many more X3D features!

https://www.hlrs.de/covise/support/
Functionality

Four file formats
- Inventor (VRML1.0)
- VRML97
- VRML97 with OpenCOVER extensions
- X3D

Many Bug Fixes
- Export selected
- Animations
- Instances
- Shell Materials
- Per Face Materials

Improved Speed (X50)
Compiling from source

Prerequisites
- CMake 3.9
- 3DS-Max API
- Cal3D
- VisualStudio 2017 Community Edition

Clone COVISE source from https://github.com/hlrs-vis/covise.git
Exporter source is located in covise/src/tools/vrmlexport
Create a build directory
Grant write access to .../Autodesk/3ds Max 2018/stdlibs
Set 3DSMAXINSTALLDIR environment variable to your Max installation directory
Run cmake-gui for CMakeLists.txt in covise/src/tools/vrmlexport
set 3DSMAX_INCLUDE_DIR if not found automatically
set CAL3D_INCLUDE_DIR if not found automatically
Create a project file and compile it.
If 3DS-Max is not running it is automatically installed in stdplugs

X3D Tutorial
Install binaries

Prerequisites
• Visual Studio 2017 runtime libraries

Download binaries from https://fs.hlrs.de/projects/covise/support/download/
Copy vrmlexp.dle to .../Autodesk/3ds Max 2018/stdplugs
Copy cal3d.dll to .../Autodesk/3ds Max 2018
Replace the original vrmlexp.dle, do not rename it.
Maya

The RawKee project developed Maya plugins to add X3D export, but their plugins are only for the older Maya versions (<= 2008).

Maya supports vrml exports through a plug-in. Load the vrml2Export.mll plug-in in the Plug-in Manager.

Starting with Maya 2016, the VRML Plug-in is retired and no longer available. The source code can be found in the Maya 2015 Devkit under obsolete: (/devkit/obsolete/games/vrml2Export).
Okino

Polytrans [https://www.okino.com/default.htm](https://www.okino.com/default.htm)

*Industrial Strength 3D format converter!*
FME

Safe Software [https://www.safe.com/](https://www.safe.com/)
Next

Applications

Authoring