X3DOM: Next-Generation Web3D Applications on Open Standards and Open Source

Web3D Consortium

www.web3d.org
Abstracting Rendering Layer with Scene Graphs

Extensible 3D (X3D)

• Refactored VRML descendant - new features, multiple encodings (XML, binary, utf-8)
• Open ISO-Standard Scene graph

X3DOM

• Profile of X3D integrating with W3C infrastructure (HTML5, CSS, DOM)
• Liberal Open Source (Javascript / WebGL)
3D Information inside the Web

- Websites (have) become Web applications

- Increasing interest in 3D for
  - Product presentation
  - Visualization of abstract information
  - Experiencing Cultural Heritage data etc.
  - Supporting decision making, e.g. in Virtual Engineering

- Enhancing user experience with more sophisticated visualizations
  - Yesterday: Flash-based site with videos
  - Today: Immersive 3D inside Browsers
X3DOM – Declarative (X)3D in HTML5
Completes today’s graphics technologies

Declarative
Scene-graph
Part of HTML document
DOM Integration
CSS / Events

Imperative
Procedural API
Drawing context
Flexible

2D
(Final HTML5 spec)

3D
(No W3C spec yet)
OpenGL + GLSL on the Web: WebGL

- JavaScript Binding for OpenGL ES 2.0 in Web Browser
  - → Firefox, Chrome, Safari, Opera
- Only GLSL shader based, no fixed function pipeline
  - No variables from GL state
  - No Matrix stack, etc.
- HTML5 <canvas> element provides 3D rendering context
  - \( gl = canvas.getContext(\text{'webgl'}) \);
- API calls via GL object
  - X3D via X3DOM framework
  - http://www.x3dom.org
Interaction via standard Web technologies (e.g. JavaScript Events etc.)

Click on `<img>` element…

```javascript
<image src="felge1_64.jpg"
onclick="...
style="...">

document.getElementById('body_color').
setAttribute("diffuseColor", '#000066');
```

…causes attribute change of `<texture>` url (i.e., other wheel rims appear)

<x3d> element

Part of DOM/HTML document like every other HTML element (e.g. `<p>`, `<img>` etc.)
X3DOM Example 2: Painting Textures of 3D Objects

HTML5 `<canvas>` element
Painted image used as texture on 3D object

<x3d> element
Part of DOM/HTML document like every other HTML element
(JavaScript implementation based on new WebGL API of HTML5 `<canvas>` element)

jQuery UI (User Interface)
jQuery JavaScript library: http://jqueryui.com/
X3DOM Application (Large Data and Picking): 3D-Internet Design Review

Maximum Visualization

- Whole car incl. modules and parts
- Whole car incl. modules
- Modules with parts
- Only parts
X3DOM Application Integration: Virtual Engineering and Cultural Heritage on the Web
Other X3DOM rendering effects

- `<directionalLight direction='0 0 -1' intensity='1' shadowIntensity='0.7'></directionalLight>`

- `<fog visibilityRange='1000'></fog>`

- `<imageTexture url="myTextureMap.jpg"></imageTexture>
  - Note: like `<material>` only as child node of `<appearance>` possible!
X3DOM.org Online Examples

• Basic Examples
  – http://www.x3dom.org/?page_id=5

• Showcase Applications
  – Dynamic Shadows on large oilrig model
    http://examples.x3dom.org/binaryGeo/oilrig_demo/index.html
  – OcculusRift, more http://www.x3dom.org/?page_id=2429

• Geometry Compression
  – binaryGeometry : http://examples.x3dom.org/binaryGeo/index.html
  – POP buffers : http://examples.x3dom.org/pop-pg13/
Entry points for getting started

1.5 Release with advanced 3D graphics features

http://www.x3dom.org/?p=3423

X3DOM online documentation and code examples

• http://x3dom.org/docs/dev/ (tutorials and docs)
• http://www.x3dom.org/school/ (12 simple examples)
• http://www.x3dom.org/iX/ (7 examples with animation)
• http://www.x3dom.org/x3dom/test/functional/ (lots of feature tests)
X3D Background & Tools

Some books:
• “X3D: Extensible 3D Graphics for Web Authors”
• “The Annotated VRML 97 Reference” (explains concepts)

More docs and tools:
• [http://doc.instantreality.org/documentation/getting-started/](http://doc.instantreality.org/documentation/getting-started/) (links to X3D)
X3DOM Benefits

- **Development costs**: Web developer vs. graphics expert
- **Adaptability**: Declarative material abstraction allows shading adoption per client hardware (e.g. GLSL, ray-tracing...)
- **Efficiency**: UI events, culling, rendering can be implemented in native code, thus utilizes battery resources efficiently
- **Accessibility**: High level navigation and interaction styles allow very late adaptations for specific use cases
- **Metadata**: Allow indexing and searching content
- **Mash-ups**: Asset reuse in new context
- **Security**: No plugins or even direct GPU calls necessary

→ **Powerful Abstraction for Web Applications !!!**
Join the Web3D Evolution!

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