X3DOM

An Overview and Examples

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Introduction

X3DOM – Purpose and High-level Overview [1]

- Experimental open source framework and runtime for X3D
  - The library is written in JavaScript
  - Implementation was initially done for discussing integration of HTML5 and declarative 3D content
- Goal
  - To have a live X3D scene that can be manipulated through HTML DOM
  - No plugins required when WebGL support is available

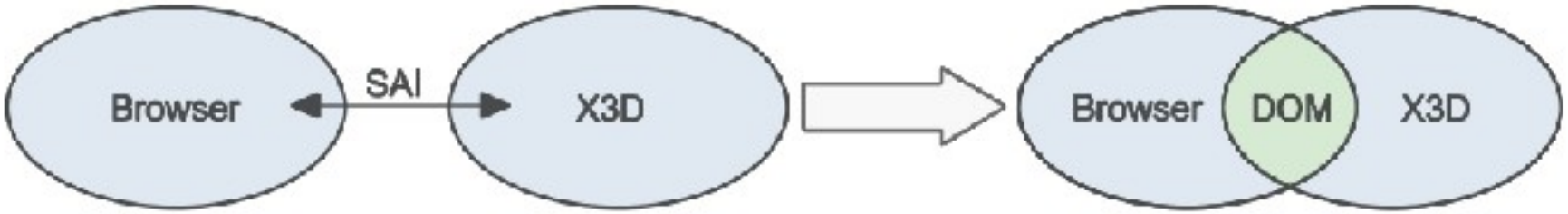
Background - X3D

- ”A royalty-free open standards file format and run-time architecture to represent and communicate 3D scenes and objects using XML” [2]
- An analogy: X3D is to 3D what SVG is to 2D (at least could be)
- A very extensive set of specifications that creates a modular architecture with layered ”profiles” [2]
- X3D Baseline Profiles: [2]
  - Interchange (geometry, texturing, basic lighting, animation)
  - Interactive (basic interaction, timing, additional lighting)
  - Immersive (full 3D graphics and interaction, e.g. audio, collision, fog, and scripting)
  - Full (all defined nodes; NURBS, H-Anim, GeoSpatial)

Background – Applying X3D in X3DOM

- When using a web browser as an X3D runtime, the focus is slightly different from the basic profiles
  - X3D defines Scene Access Interface (SAI), but web browser readily provide DOM
  - Browsers also readily implement scripting capabilities (JavaScript)

→ X3DOM group proposes a new X3D profile, HTML that extends X3D-Interchange profile[3][4]



X3DOM integration model[3]

X3DOM – Status of the Implementation[5]

- Homepage: http://www.x3dom.org/
- Dual licensed under MIT and GPL licenses.
- Latest stable version is 1.1 (22.10.2010)
  - Version 1.0 released 7 months earlier
- More recent dev version is also available
  - Under active development
  - Already new features such as navigation modes and smooth camera animation added to dev version[6]
- Roadmap available up to version 1.2[7]

X3DOM - Features

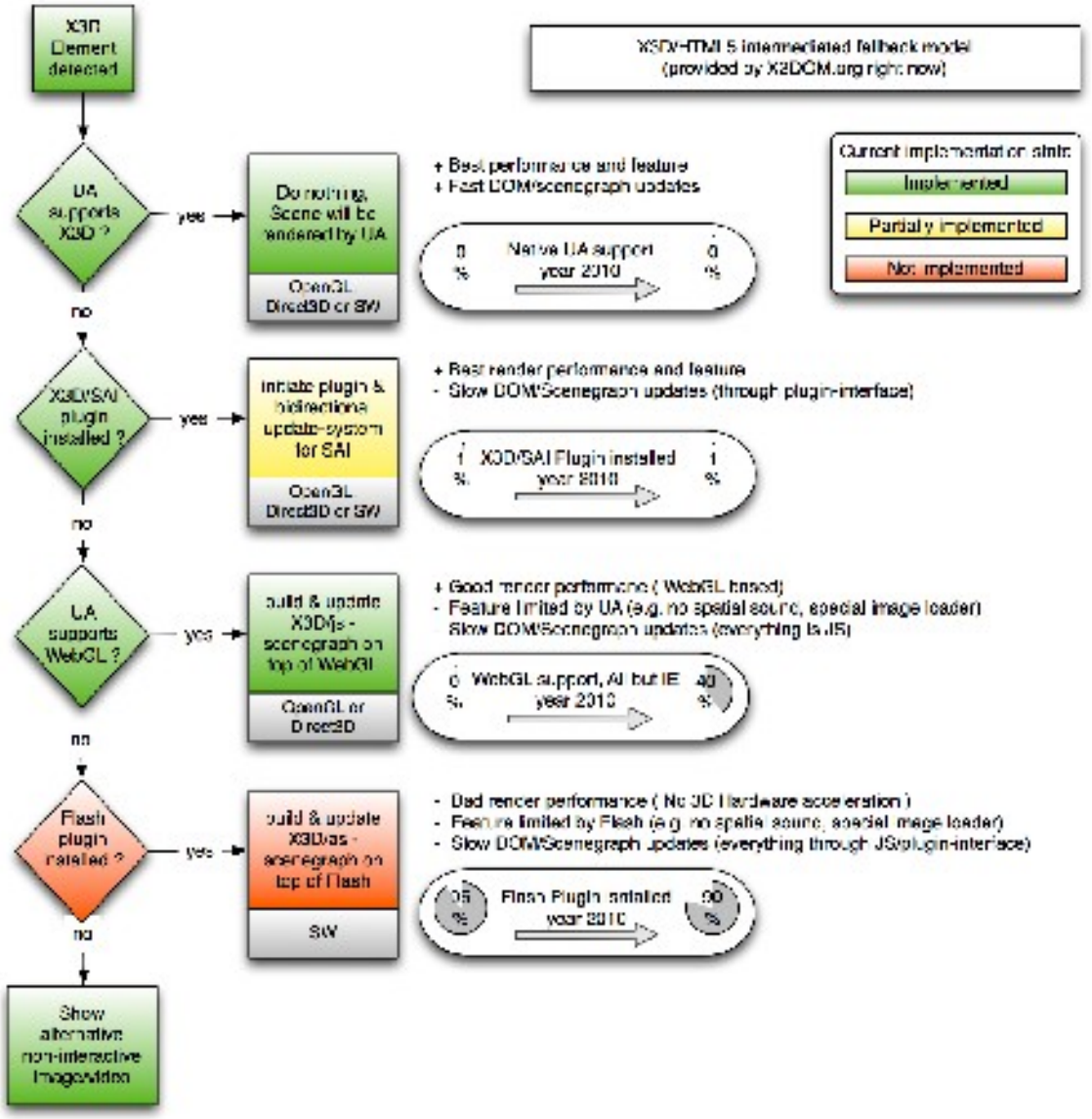
- A complete list of features is missing
  - Release notes for version 1.0 and 1.1 list new features
  - Examples in the homepage demonstrate some features
- Features (as we know)
  - Support for loading and displaying X3D models
  - Manupulation of the scene via DOM
  - HTML events (*onclick*, etc.) on 3D objects
  - Support for large meshes (>65k indices per mesh)
  - Textures (images and movies) and sound
  - Transparency, fog and shadows
  - Multiple light sources (spot, point, directional)
  - Animations (mesh, camera)
  - Fallback model for non-WebGL browsers

Technical Overview

Technical Overview

- Library in a single JavaScript file (*x3dom.js*)
- When loaded, creates new a DOM object, *x3dom*
- When loaded, X3DOM automatically parses the HTML document for 3D-models
  - Specifically, 3D-models specified inside <*x3d*> tag
- 3D model is displayed using best possible alternative, according to a fallback model (see next slide)
  - Theoretically speaking, a web browser could natively support displaying X3D models (option 1)
  - Second preferred alternative is an X3D/SAI plugin (2)
  - WebGL is only the third alternative in the model (3)
  - Non-webGL browser could still use Flash (4)
  - If everything else fails, display alternative content (5)

Fallback-model[8]



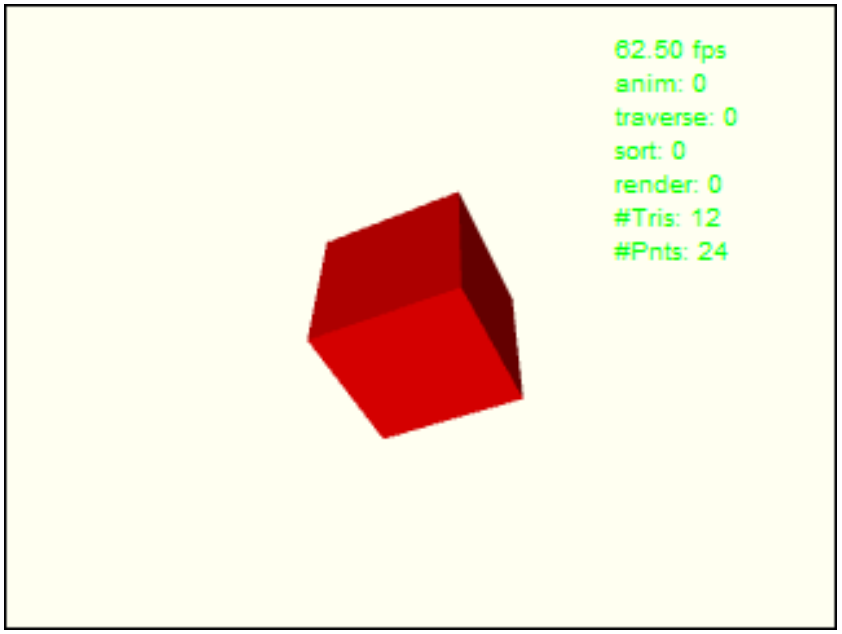
Technical Overview (Continued)

- Key in X3DOM's usage is X3D markup
  - A standardised binding for XML is available[9]
- Navigation capabilities are provided by the library (dev version)
- Build-in navigation modes[10]
- → X3DOM is an X3D model viewer/player for web browsers

Examples

”Hello World” (1/2) [11]

- Hello X3D World – demonstrates how a simple X3D scene can be displayed in browser



”Hello World” (2/2)

- HTML file structure:

```
<!DOCTYPE html … >
<html xmlns="http://www.w3.org/1999/xhtml">
  <body>
    <X3D xmlns="http://www.web3d.org...” width=...>
      <Scene>
        <Shape>
          <Appearance>
            <Material diffuseColor='1 0 0' />
          </Appearance>
          <Box DEF='box'/>
        </Shape>
      </Scene>
    </X3D>
    <script type="text/javascript"  src="x3dom.js"></script>
  </body>
</html>
```

XHTML document

Embedded X3D content

Loads X3DOM library

Render Feature Examples

- Single Mesh Model with flat hierarchy
  - http://x3dom.org/x3dom/example/x3dom_singleMesh-small.xhtml
- Multiple textures:
  - http://x3dom.org/x3dom/example/x3dom_texture.xhtml
- Multiple animated lights:
  - http://x3dom.org/x3dom/example/x3dom_animatedLights.xhtml
- Fog:
  - http://x3dom.org/x3dom/example/x3dom_fog.xhtml
- Shadows:
  - http://x3dom.org/x3dom/example/x3dom_shadows.xhtml

Navigating an X3D Model

- http://x3dom.org/x3dom/example/x3dom_walkThrough.html
- Navigate using X3DOM's built-in navigation keys:
  - Examine mode ('E') – rotate, pan, zoom, set center of rotation
  - Walk mode ('W') – move forward/backward
  - Fly mode ('F') – same as walk
  - Look at ('L') – move closer/farther

Mashup Application Example

- Ajax Mashup: Combining Flickr Data and Physics
  - By Michael Zoellner
- http://dev.m05.de/x3dom/flickrdump/

Evaluation

Evaluation (1/2)

- Benefits
  - Easy to start using
  - Works as an X3D player without any additional programming
  - Integration to DOM → nicely works with for instance jQuery
  - Has a fallback model for non-WebGL browsers
- Drawsbacks
  - Scattered documentation (a lot of examples, not
  - More like an X3D player than a WebGL framework
  - Supports only X3D content (conversions needed)
  - Fallback model is, well, just a model – it has not been fully implemented
  - Testing not comprehensive

Evaluation (2/2)

- General Usefulness
  - *Sweet spot:* display X3D content in web browsers
  - Stable enough for most prototypes, stability for production is very questionable
  - The more you need low-level customisations, the less useful X3DOM is
- Measurements
  - Active community, but … very much W3C/Web3D driven → reference implemention is more important than production-readiness

Summary

Summary

- X3DOM is a maturing X3D library for web browsers
  - Not actually a WebGL framework, but more like an X3D viewer with notable emphasis on WebGL
- Fulfills its promise in exploring X3D's HTML integration
  - From this point of view, the library is surprisingly good
- At this point, could recommend for content-driven prototyping
  - For instance, when we already have X3D content which we want to display in a web browser

Thank you!

- Questions?

References

[1] http://www.x3dom.org/?page_id=2

[2] http://www.web3d.org/about/overview/

[3] http://www.x3dom.org/?page_id=158

[4] Behr, J., Eschler, P., Jung, Y., Zöllner, M. (200). X3DOM – A DOM-based HTML5/X3D Integration Model. In Web3D '09: Proceedings of the 14th International Conference on 3D Web Technology.

[5] http://www.x3dom.org/?page_id=7

[6] http://www.x3dom.org/?p=1443

[7] http://sourceforge.net/apps/trac/x3dom/roadmap

[8] http://www.x3dom.org/?page_id=7

[9] http://www.web3d.org/x3d/specifications/ISO-IEC-19776-X3DEncodings-All-Edition-1/

[10] http://www.x3dom.org/?page_id=293

[11] http://x3dom.org/x3dom/example/x3dom_helloWorld.html