3D on the Web

Why We Need Declarative 3D
Arguments for an W3C Incubator Group

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Agenda: 3D on the Web

- Why We Need Declarative 3D
  - Philipp Slusallek, DFKI & IVCI
- Overview of XML3D
  - Kristian Sons, DFKI
- Overview of X3DOM
  - Johannes Behr, IGD
- Open Discussion
  - All of us
Executive Summary: 3D for the Web

- 3D graphics is hampered by limited availability
  - 3D technology and games are everywhere
  - But sharing of 3D content is severely limited
- Web allows sharing 3D content (just like video)
  - Extend Web/HTML5 with *interactive 3D graphics*
  - Provide industrial-strength graphics capabilities
  - Provide space for innovation above OpenGL/DX
- Need to adapt 3D graphics for the Web
  - Must work for non-experts (its a *means*, not a *goal*)
  - Provide *easy 3D* for millions of Web developers

➤ W3C: Important role for 3D on the Web
Why Not Just Use ...?

- **VRML/X3D**
  - Not compatible with HTML, separate format & files
  - Many new and incompatible concepts
    - DAG vs. tree, own scripting (S/EAI), own event model, ...
- **Collada**
  - Exchange format, not designed for interaction/Web
- **WebGL**
  - *Low level API* only, hard on Web developers
  - Not indexable or searchable
  - Many new scene graph APIs, why not use the DOM?
  - Limited to OpenGL ES 2.0 (2007), closely tied to HW

➤ **W3C: Declarative answer for 3D on the Web**
But What About Content Creation?

- **Video**
  - Easy: point & click with video camera/mobile phone

- **3D Graphics**
  - Initial creation of a 3D model is hard
    - But computer vision research is making good progress
      3D from images, laser scanners, depth cameras, etc.
  - Reuse of content is simple: *Network effect*
    - The more is available the easier it gets to create new
      3D geometry, materials, lights, ...
    - Index & search becomes vital (needs indexable content)

▶ 3D should be in searchable Web documents!
Motivation

• Compare to Video Technology
  – Technology had been there in the mid 1990ies …
  – … but nothing happened

• Video on the Web: YouTube (2005)
  – They allowed *anyone* to *easily* add video to the Web
    – Everyone could: create, share, experience video
  – Today: 2 billion views per day
  – Revenue of $1.1 Billion (target for 2011)

▷ Can we repeat something similar for 3D?
Motivation

- **3D graphics is becoming a commodity**
  - Embedded GPUs everywhere (e.g. mobile devices)
  - 3D stereo in movies, moving to consumer
  - High-bandwidth (mobile) Internet access
  - Client and server side/cloud rendering
- **But not easily usable for the Web**
  - Exclusively focused on games (plus some CAD, etc.)
  - Specialized content for specialized engines (and v.v.)
  - Needs skilled OGL/DX and content developers

► **Need to adapt 3D graphics for Web**
New Market Opportunities

- New cultural and social opportunities
  - Virtual museums, eLearning, social interaction, …
- Novel entertainment and gaming markets
  - Online worlds, 3D gaming, interactive “movies”, …
- Interactive product presentations
  - Product catalogs, online configuration, tourism, …
- Collaborative engineering and interaction
  - Product design, dual reality, production, marketing, …
- Visualization and interaction as a services
  - 3D readily available and easy to use on any device
New Market Opportunities

• Consequences
  – New business cases (every user, every platform)
    – Needs many more developer
    – 3D-graphics a *means*, not an *end*
  – Support “arbitrary” 3D content
    – Game engines not sufficient → industrial strength graphics
    – Developer and users expect things to “just work”
  – Take advantage of millions of web developers
    – Reuse their skills: Merge graphics into web programming
  – Integration with the rest of the Web technologies
    – Make 3D part of Web document/DOM (→ search, etc.)
    – Need semantics to go beyond pure graphics data
Proposal: Declarative 3D On The Web

- Make it easy to add 3D to Web pages
  - Fully integrate 3D content into HTML5 documents
    - Interactive 3D graphics as first class DOM objects
  - Reuse existing Web technology wherever possible
    - Avoid barrier to entry – make Web developers feel at home
    - Do not add new concepts, unless absolutely necessary

- Jump start 3D on the Web
  - Freely provide necessary technology
    - Specification of HTML extensions & standardization
    - Native browser & JS implementations, server side, …
  - Tutorials, examples, hosting, …
  - Joint initiative with research and industry
Structure of Content: 2D Web

- **Server-Side Application**
  - Document generation
  - asynchronous http access (AJAX)
  - DOM Script

- **HTML Document**
  - Content
  - DOM
  - Resource references
  - Events
  - Access & Modification

- **Style Sheets (CSS)**
  - Reference or inline

- **Resources (image, video)**
  - Reference or inline

- **Style**
  - Reference

- **Interaction**
  - DOM Script

- **Server**

- **Client**

- **Server-Side Application**
  - Document request
# Structure of Content: 2D versus 3D

<table>
<thead>
<tr>
<th></th>
<th>2D</th>
<th>3D</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Content</strong></td>
<td>text, structure, image, video</td>
<td>geometry, structure, shader, texture</td>
<td>HTML &amp; resources</td>
</tr>
<tr>
<td><strong>Style</strong></td>
<td>layout, color, font</td>
<td>transformations, shader assignment</td>
<td>CSS</td>
</tr>
<tr>
<td><strong>Interaction</strong></td>
<td>selection, animation</td>
<td>selection, animation</td>
<td>DOM scripting</td>
</tr>
</tbody>
</table>
Integrating 3D into the Web

XML
DOM
HTML5
CSS
3D
AJAX
Javascript
RDF
SVG

W3C
Millions of Web programmers
What's Special About 3D?

• Visual formatting model not applicable in 3D
  – No Box model for layout in 3D
  – 3D space typically unlimited
  ▶ Not needed, use absolute 3D transformations

• Re-use of objects (instancing)
  – Possible in SVG, not in HTML
  – Important for geometry, shaders, transformations, …
  – Avoid conflicts with CSS inheritance
  ▶ Use relative URLs (fragments) and only CSS
What’s Special About 3D? (Cont.)

• Programmability (shaders)
  – HTML, SVG, and CSS have “fixed function shading”
  – 3D heavily relies on *programmable shaders*
    – Would not be competitive without programmability
    – Shader types: material, light, geometry, …
  – Need portable solution
    – Many incompatible languages: glsl, HLSL, Renderman, …
  – Needs generic data definitions
    – Almost arbitrary input parameters, but fixed types
  ▶ Add special element where needed
  ▶ Assign via CSS as in HTML
What’s Special About 3D? (Cont.)

• Large data sets
  – Much larger than text: 3D geometry, textures, …
    – Similar to images/audio in HTML
    – But with rich internal structure → DOM
    – DOM APIs are not designed for this: Access is via text
  – Optimized handling in 3D engine
    – No duplicate storage of data (especially not as text)
  – Compression for transfer and parsing (e.g. EXI, FI)

➤ Efficiency via optimized management/rendering
➤ Data should be stored once on 3D side
➤ Access via DOM API extension (typed arrays)
What’s Special About 3D? (Cont.)

• Dynamic changes to data
  – Need efficient processing of large data sets
    – Animation, image processing, physics, …
  – Should be able to exploit data parallel HW
    – Power efficiency of Javascript?
  ▶ Declarative and safe exposure of data-parallel HW

• Interactivity
  – More complex 3D interaction metaphors
  – Different input devices (e.g. multitouch, 3D mouse, …)
  – Continuum from basic to application/data-dependent
  ▶ For now: rely on JS libraries
Summary

- **Ongoing Activities**
  - German Spitzencluster Project (IGD & DFKI, w/ SAP, …)
  - DFKI
    - EU Future Internet PPP (with Disney, BlackRock, …)
    - GIS-Integration on the Web (Caigos)
    - 3D Characters in Web
  - IGD
    - Cultural Heritage (IGD)
    - Visualization of Simulation Results (IGD)
  - XML3D is focus at Intel Visual Computing Institute:
    - Capturing 3D for Web, Shading, Programming, Gesture, Interaction, …
Summary

• Main take-away
  – 3D will be a hot topic – particularly on the Web
  – W3C should play major role for *declarative 3D*
  – Two fully working prototypes: XML3D and X3DOM
  – DFKI, IVCI, and IGD joining forces

► Feedback from and interaction with W3C
► Aim: Launch Incubator Group for discussions

Visit http://www.xml3d.org