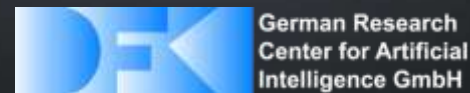


Fortress City Saarlouis

Development of an interactive 3D
city model using Web technologies

Kristian Sons, Georg Demme, Wolfgang Herget, Philipp Slusallek





Project



Saarlouis

- History
 - Build as fortress 1680
 - Constructed by Vauban
 - Hexagonal floor plan
 - Prussians modified city in 19th century



Saarlouis Municipal Museum

- Diorama existed
 - Only French era
 - Hard to maintain
 - Hard to integrate additional information
- Movie existed
 - 3D City Model
 - Offline rendering
 - Modeled by DFKI



How to make **interactive** model available?



Internet

- Best medium to make the model available to broad audience
 - But:
 - Limited 3D capabilities
 - Large model
 - 3D Plug-ins have low penetration rate
- Approach
 - Now: Develop Terminal Application
 - Later: Publish on the Internet



Terminal

- Two target groups
 - Individual visitors
 - Groups of 1-5
 - Usually elderly
 - School classes
 - 20-30 pupils
- Two setups
 - Single-touch Terminal
 - 40" Stereo Display



Technology

- Standard Web Technologies for 2D
 - Browser in Kiosk mode
 - HTML: Text and Images
 - CSS: Layout
 - JavaScript:
 - Application logic
 - Navigation
- Include Web designers
- What to use for 3D graphics?





XML3D

3D applications on the Web

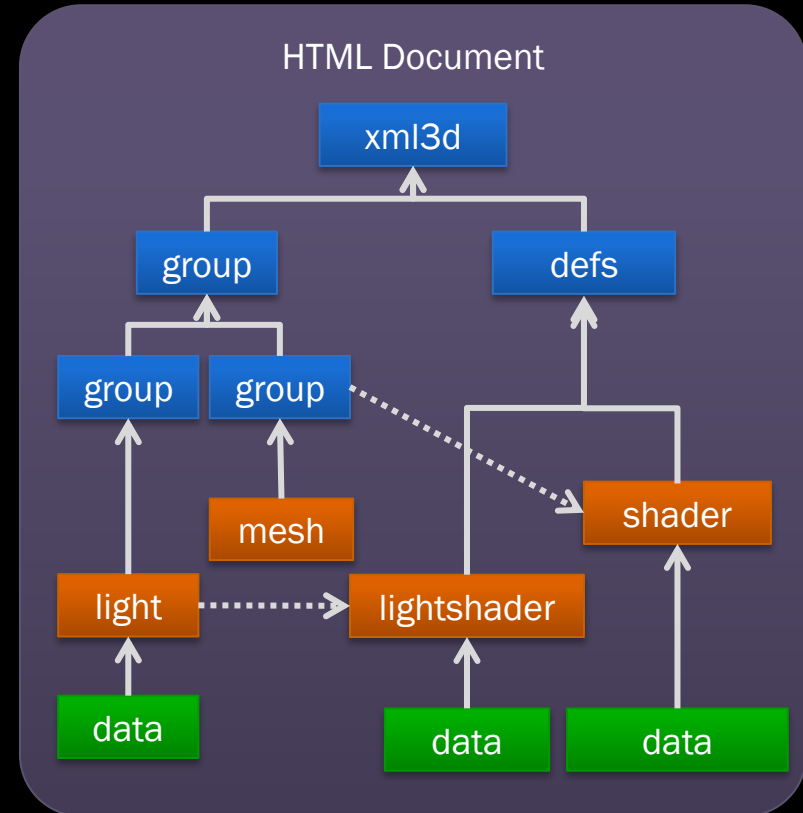
- Web evolved to full-fledged application platform
- 3D graphics today a commodity
- Still hardly any 3D content on the Web
- WebGL is there
 - Too low-level for web developers?



We want declarative 3D graphics for the Web

3D as extension to HTML5

- Integrate 3D content into HTML5 documents
 - First class objects in the Document Object
 - Reuse existing Web technology wherever possible
 - Avoid barrier to entry
 - Make Web developers feel at home
 - Do not add new concepts, unless absolutely necessary



XML3D Elements

<xml3d>

- Canvas for XML3D content
- Embed into (X)HTML

<defs>

- Definition of resources

<group>

- Structuring and transformation hierarchy

<transform>

- Alternative transformation syntax,
- Can be referenced via CSS

```

<body>
<h1>XHTML Document</h1>
<xml3d style="width: 640px; height: 480px"
  xmlns="http://www.xml3d.org/2009/xml3d">

<defs>
  <transform id="xfm1" translation="3 0 1"/>
  <transform id="xfm2" scale="2 2 2" />
</defs>

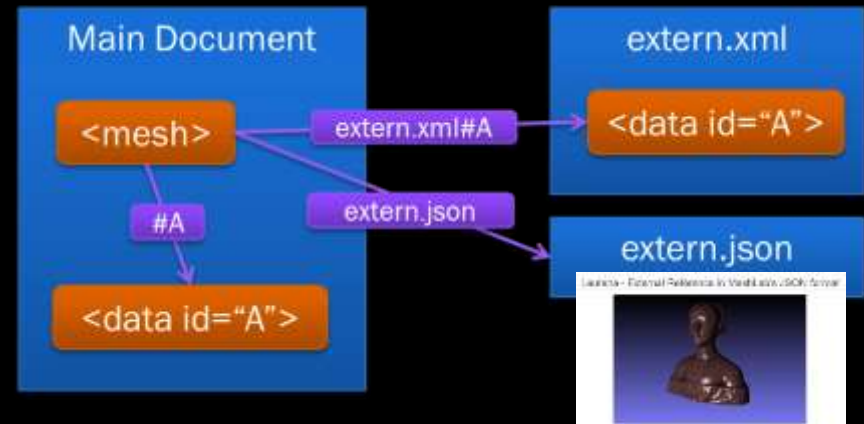
<group style="transform:url(#xfm1)" >
  <group class="scaleMe" >
    <mesh ... />
  </group>
  <group style="transform:scale3d(3,1,3)"
    <mesh ... />
  </group>
</group>

</xml3d>
</body>

```

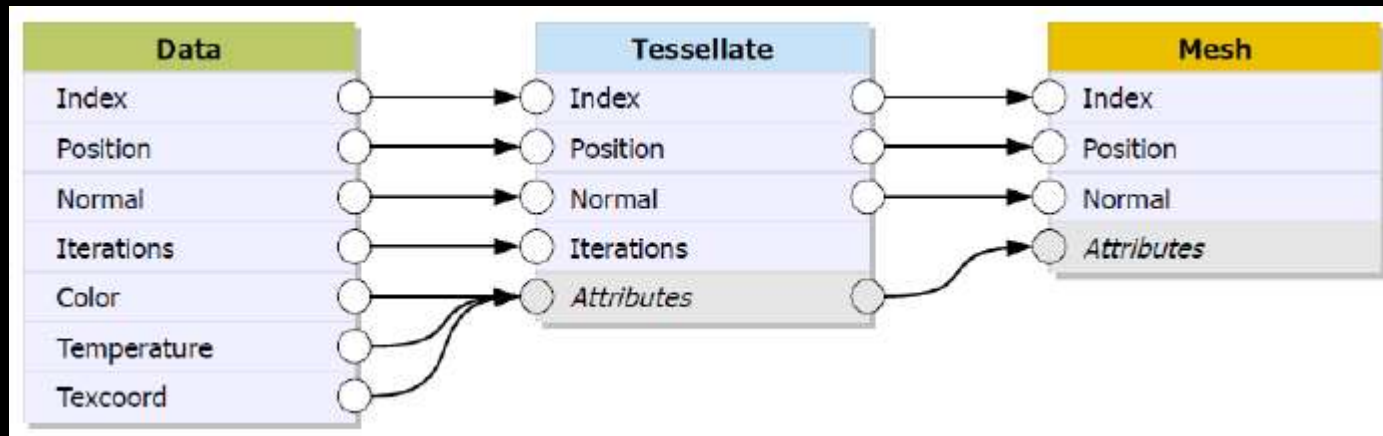
XML3D Resources

- Ways to reference data resources:
 - In the same document
 - External resources
 - Element within external resource
- General concept
 - Applies to geometry, materials, animations, transformations, etc.
 - Various external formats supported
- Allows fine-granular scene composition
 - E.g. in a REST architecture



Xflow - Data Processing

- Declare dataflows to describe data modifications
- Apply **operator** on <data> via compute attribute
- Allows to create dynamic effects
 - Skinning and morphing for character animation
 - Animation of shader parameters
 - Image processing and Augmented Reality



XML3D Interaction

DOM Scripting

- Well known to Web developers
- Arbitrary scene graph modifications
- Convenience libraries
 - e.g. jQuery

DOM Events

- Event attributes
- 3D specific data

```

<xml3d ... >
<defs>
  <transform id="xfm1" translation="0 0 0" />
</defs>

<group id="black_queen"
  style="transform: url(#transform1)">
  <mesh type="triangles"
    onmouseover="setColorOver(this);"
    onmouseout="resetColor(this);">
    ...
  </mesh>
</group>
...
</xml3d>

```



Implementations

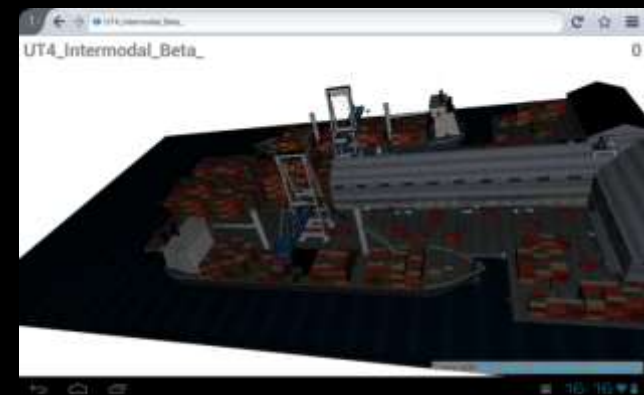
- Native

- Modified Firefox and Chrome
- Rendering: OpenGL4 or RTFact Ray Tracer

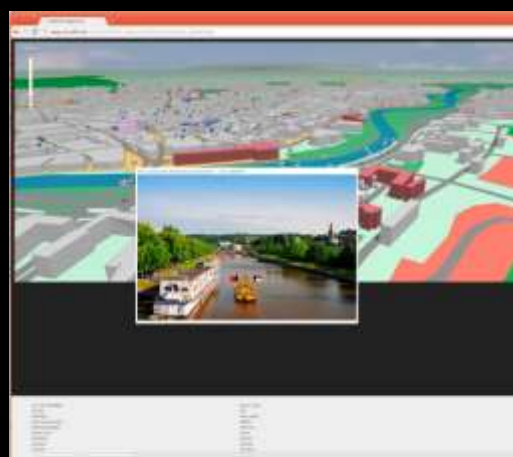
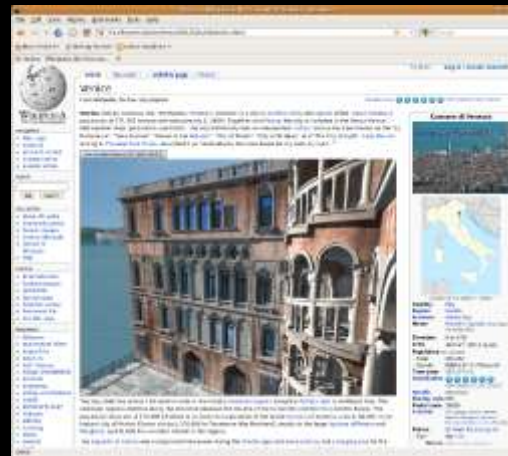


- Polyfill

- JavaScript library
- Rendering with WebGL
 - Based on OpenGL ES 2.0
- Multi-platform
 - Desktop: Windows, Linux, Max OS
 - Mobile: Android



XML3D Applications





Implementation

Approach

- Use native XML3D-Chrome with OpenGL
 - Large scene
 - HDTV resolution
- Skeletal framework of application
 - In collaboration with museum
 - Regular reviews
- Museum to define:
 - Text content
 - Images: Maps, Drawings, etc.
 - Points of Interest (POIs)

Setup

- Touch terminal
 - Single touch display
 - Large UI elements
 - Limited degree of freedom
- External monitor
 - Active stereo rendering
 - 3D content only
 - VR system (Lightning)
 - Synchronized via WebSockets



Modes



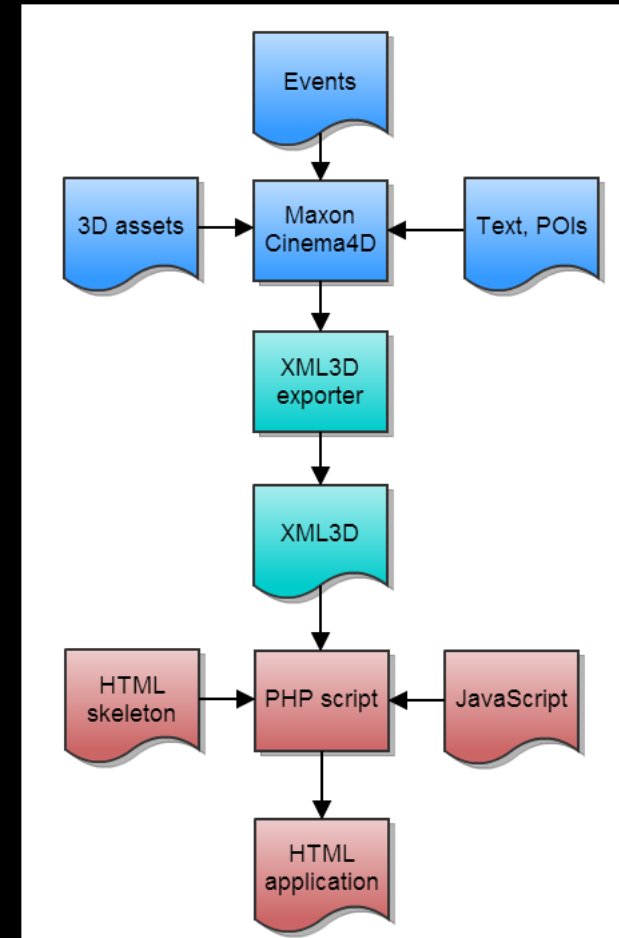
Modes

- Points of Interest (POI)
 - Inspect specific object
 - Background information
- Panorama
 - Choose a point and look-around
 - Information markers above POIs
- Virtual City Tour
 - Fly-through on static path
 - Possible to stop and switch to Panorama
- Free-flight mode
 - For museum staff only



3D Content Pipeline

- Prepare 3D model
 - Simplified existing movie version
 - Merged two eras into one
- Annotate 3D model
 - Text content
 - Event attributes
 - onmouseover, onclick, etc.
 - Reference images
- Export model
 - XML3D for Browser
 - VRML for VR system



Development Process

- 3D modeler
 - Model, annotate, and export 3D content
 - Create renderings for UI
- Web designer
 - User Interface
 - Layout with HTML and CSS
- Web developer
 - Integrate 2D with 3D
 - Some XML3D knowledge
 - Interaction and application logic





Results

Results

- Streamlined development process
- Involved Web designer and Web developer
- Reuse existing technologies
- Easy to integrate 3D with 2D content
- Application runs successfully in museum
 - Stable
 - Well received by visitors



Future Work

- Multi-language support
- Switch eras
 - Dynamically during run-time
- Publish on Internet
 - Adapt for JS/WebGL implementation
- Data mining
 - Improve based on user data
- Include 3D avatars

Standardization

- Founded W3C Community Group
 - “Declarative 3D for the Web Achitecture”
- Collaboration with Fraunhofer, Web3D, EDF,...
- Two Evaluation Platforms
 - XML3D and X3DOM
- Targets:
 - Improve browser support for declarative 3D
 - Native support of a unified declarative format



Acknowledgments

- This work was supported by
 - EU Project VERVE
 - EU Project FI-CONTENT
 - Intel Visual Computing Institute



Thank you!

Questions?

<http://www.xml3d.org>

<https://github.com/xml3d/xml3d.js>

<http://www.w3.org/community/declarative3d/>