Webized 3D experience by HTML5 annotation in 3D Web

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Motivation
Motivation

• With the development of 3D Web technologies, 3D objects are now handled as HTML markup without plug-ins on web pages

• However, although declarative 3D objects are physically integrated into web pages, the 3D objects still involve the same separation of the HTML element from the perspective of the 3D layout
Previous work
Previous work

Integration of the 3D Web:
(a) 3D object on the Web and (b) a 3D object with HTML annotations

Previous work

X3DOM example of 3D-Scanned CH model with metadata

X3D MovieTexture example

http://examples.x3dom.org/v-must/Summerschool/index.html

http://examples.x3dom.org/example/x3dom_video.xhtml
Our approach
Webizing 3D experience

• Webizing
  o A means of bootstrapping the Web using a large amount of legacy information [Berners-Lee 1998]

• Our Method
  o Web annotations to declare the relationship between 3D target object and HTML annotation elements to share the 3D layout context on the 3D Web using web technologies

## 3D Web annotation

<table>
<thead>
<tr>
<th></th>
<th>Legacy 3D Web content</th>
<th>Declarative 3D</th>
<th>Webized HTML5 annotation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanism</strong></td>
<td>MIME</td>
<td>DOM integration</td>
<td>3D context sharing</td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td>X3D</td>
<td>X3DOM, XML3D</td>
<td>Proposed</td>
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<tr>
<td><strong>Annotation schema</strong></td>
<td>?</td>
<td>?</td>
<td>Schema.org</td>
</tr>
<tr>
<td><strong>Rendering model</strong></td>
<td></td>
<td>Separate Canvas</td>
<td>Sharing 3D context of 3D scene and HTML annotation</td>
</tr>
<tr>
<td><strong>Media type</strong></td>
<td>2D page media</td>
<td>2D page media</td>
<td>3D place media (CSS extension)</td>
</tr>
<tr>
<td><strong>Limitations</strong></td>
<td>Separation of 3D context between contents (3D and HTML resources)</td>
<td>Separation of 3D context between contents (3D and HTML resources)</td>
<td>Depth buffer sharing issue (not resolved yet)</td>
</tr>
<tr>
<td><strong>Advantage</strong></td>
<td></td>
<td>No-plugins</td>
<td>Any HTML5 resources</td>
</tr>
</tbody>
</table>
Integration of HTML and 3D Web

- **Previous**
  - CSS Paged Media
  - 2D Space

- **Proposed**
  - CSS Place Media [Ahn 2014]
  - 3D Space

Webizing 3D experience with annotation
Semantic annotation on 3D Web

Webizing annotation schema for the 3D Web experience

<table>
<thead>
<tr>
<th>Property</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>target</td>
<td>URL</td>
<td>3D target object's DEF attribute value of the annotation</td>
</tr>
<tr>
<td>translate</td>
<td>Integers</td>
<td>Defines a translation</td>
</tr>
<tr>
<td>rotate</td>
<td>Integers</td>
<td>Defines a rotation (degree)</td>
</tr>
<tr>
<td>scale</td>
<td>Integers</td>
<td>Defines a scale transformation</td>
</tr>
<tr>
<td>contentURL</td>
<td>URL</td>
<td>URL of an external web page to annotate on 3D target object</td>
</tr>
</tbody>
</table>

```xml
<x3d>
  <Transform translation='81 0 0'>
    <Scene>
      <Shape DEF='earth'>
        <Sphere radius='3.9'/>
        <Appearance>
          <Material diffuseColor='1 1 1'/>
          <ImageTexture url='images/texture_earth_clouds.jpg'/>
        </Appearance>
      </Shape>
    </Scene>
  </Transform>
</x3d>
```

```html
<div vocab="http://schema.org" typeof="AnnotationObject" id="earth_annotation">
  <div property="translate" class="annotation_property">0, 0, 150</div>
  <div property="rotate" class="annotation_property">0, 0, 0</div>
  <div property="scale" class="annotation_property">1, 1, 1</div>
  <div property="target" class="annotation_property">#earth</div>
</div>
<p>
  Earth<br>
  Orbit Velocity: 107,218 km/h<br>
  Equatorial Circumference: 40,030 km<br>
  From Sun: 149,598,262 km<br>
  <iframe src="https://www.youtube.com/embed/thuVi6xRd_w?......"></iframe>
</p>
</div>
```
Prototype implementation
Prototype implementation

Web Browser

Scene Graph Renderer
- X3D Renderer
- CSS 3D Renderer

Scene Graph Integrator
- Webized 3D Scene Graph
- HTML DOM
- DOM Annotation

Content Store Provider
- HTML
- X3D
- HTML/X3D

HTTP Get

HTML/X3D
Experimental results

• Separate rendering results of the 3D Web

3D object rendering on the 3D Web

Web annotation rendering on the 3D Web
Experimental results

3D planet objects in solar system
Experimental results

- 3D architectural CAD model of a house

User experience annotation on 3D model

Transforms web annotation of user experience on 3D model
Discussion and future work
In this study, we proposed a method for webizing 3D experience by web annotation to express user experience on 3D Web

- Uses web annotation model to declare relationship between user experience and 3D objects
- Renders them based on the relationship to share layout and camera perspective in 3D context
- Has advantage to use existing sophisticated media and application library resources of current web technologies on the 3D Web
Discussion

• Interaction with HTML element on 3D Web

OGV and MP4 MovieTexture example
Example shows how you can easily provide multiple video-sources in a single MovieTexture Node
(Only OGV work in Minefield right now. WebKit only plays the mp4 sound)

X3D MovieTexture example
http://examples.x3dom.org/example/x3dom_video.xhtml

Webized annotation on the 3D Web using Video, YouTube, and video tag of HTML
Discussion

- Rendering 3D objects with annotation on 3D Web

X3DOM example of 3D-Scanned CH model with metadata

Webized annotation on the 3D Web with 2D and 3D layout annotated objects

http://examples.x3dom.org/v-must/Summerschool/index.html
Limitation and Future work

• Limitation
  o Our prototype implementation is limited to sharing the context of 3D layout and the context of the annotated content

• Future work
  o Applying our method to 3D CAD system
Thank you

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