WEB3D 2021
CONFERENCE

VIA: Visibility-aware
Web-based Virtual Reality

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Presentation Overview:

1. Background
2. Problem, Causes and Solutions
3. Demo
4. Experiments and Results
5. Questions
Background
What is WebXR?

- Built on top of WebGL to enable VR and AR on the web
- Uses the glTF 2.0 format to transfer Graphics information

https://www.w3.org/TR/webxr/
What is glTF?

- Stores 3D graphics info in images, raw binary, and JSON-like description File

https://www.khronos.org/gltf/
Problems, Causes, and Solutions
Problem: Long loading Times for WebXR

- Load Times for WebXR scenes are incredibly long for mobile networks.
- Web page downloads sequence of objects (from glTF metadata)
Cause 1: Geometry data contained in monolithic resource files

- Monolithic Resource Files (.bin) for 3D scenes must be downloaded before any object may be rendered
- Typically 1 .bin and many image files
Cause 2: Arbitrary download order of textures

- Texture files are downloaded in arbitrary order
General Approach

- Solve cause 1 by partitioning files by object
- Solve cause 2 by prioritizing object files in view.
Object Prioritization Heuristics

- **Heuristic 1: View Frustum Culling**
  - Prioritize downloading objects in the field of view.

- **Heuristic 2: Look-At-Rotation Penalty**
  - Prioritize downloading objects that only require smaller rotations to look at.

https://www.gamedev.net/tutorials/programming/general-and-gameplay-programming/frustum-culling-r4613/
VIA System
Architecture Overview

Object Scoring (§V-B)

Scene metadata
(glTF with object-data
buffer dependencies $R_j$)

User’s Position
and Orientation

Alg. 1

Parse
Axis-Aligned
Bounding Boxes

Rotation Score

View Frustum
Culling

Score Heuristic

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Demo
Experiments & Results
Experiment Setup

- 5 test scenes.
- Control, VIA, and VIA-Image (VIA but only image sorting)
- 3 different Network bandwidths covering typical mobile network conditions.
Experiment Results

- VIA has strictly lower latency than Control, especially on slower networks.
- Occasionally VIA-Image has similar benefit as full VIA.
Network Dependence

- Larger improvement over Control on slower networks.
- VIA introduces extra Round Trip Time from all the extra requests.
View Dependence

- Improvement of VIA over control is highly dependant on initial Viewpoint.
- Initial views with less objects had the largest improvement.

<table>
<thead>
<tr>
<th>Objects in view</th>
<th>Control</th>
<th>VIA-image</th>
<th>VIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only 3</td>
<td>423</td>
<td>282</td>
<td>156</td>
</tr>
<tr>
<td>282</td>
<td></td>
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</tbody>
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View Mis-estimation

- How well does VIA perform if the assumed initial view is off from the actual initial view?
- Good as long as it’s within 90 degrees.
Thank You!
Questions?