Perspective Correction

CS418 Computer Graphics
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Texture Mapping
Interpolation

- Rasterization interpolates texture coordinates \((s,t)\) defined at vertices to provide texture coordinates at each fragment.
Interpolation

- Rasterization interpolates texture coordinates \((s,t)\) defined at vertices to provide texture coordinates at each fragment.

- Interpolation is NOT LINEAR.
Receding Sidewalk
Texture Coordinates
Sidewalk Seams
Linear Interpolation
Perspective Correct
Perspective Correction

\[ d = \frac{1}{y} \]
\[ \text{canvas} = \frac{y}{w} = \frac{y}{(-z/d)} \]
\[ y_{\text{front}} = -\frac{1}{(-z_{\text{front}})}, \quad y_{\text{half}} = -\frac{1}{(-z_{\text{half}})}, \quad y_{\text{back}} = -\frac{1}{(-z_{\text{back}})} \]

(Vertical positions vary by interpolating denominator)
Perspective Correction

- Clip coordinate vertex attributes: 
  \((x, y, z, w, s, t, 1)\)
- Window coordinate vertex attributes: 
  \((x/w, y/w, z/w, 1, s/w, t/w, 1/w)\)
- Window vertices at \((x/w, y/w)\)
- Rasterization linearly interpolates
  \((s/w, t/w, 1/w)\) from vertex attribute values to find fragment values
- Divide \textit{per-fragment} by \(1/w\) to get perspective correct interpolated texture coordinates \((s, t)\)
Example

\[ y_{\text{canvas}} = y/(-z/d) = y/w \]
Example

\[ y_{\text{canvas}} = \frac{y}{-z/d} = \frac{y}{w} \]

\( t/w = 1/9 \)
\( 1/w = 1/9 \)

\( t/w = 0 \)
\( 1/w = 1 \)

\((0,0,0)\)

\( z = -1 \)
\( y = -1 \)
\( w = 1 \)
\( t = 0 \)

\( .25 \)
\( .5 \)
\( .75 \)
\( 1 \)
Example

\[ y_{\text{canvas}} = y/(-z/d) = y/w \]

<table>
<thead>
<tr>
<th>z = -1</th>
<th>-3</th>
<th>-5</th>
<th>-7</th>
<th>-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>y = -1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
<td>-1</td>
</tr>
<tr>
<td>w = 1</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>t = 0</td>
<td>0.25</td>
<td>0.5</td>
<td>0.75</td>
<td>1</td>
</tr>
</tbody>
</table>

\[ t/w = 1/9 \]
\[ 1/w = 1/9 \]
\[ t/w = .5/9 \]
\[ 1/w = 5/9 \]
\[ t/w = 0 \]
\[ 1/w = 1 \]

\[ t = 1.0 \]
\[ t = 0.0 \]
Example

\[ y_{\text{canvas}} = \frac{y}{(-z/d)} = \frac{y}{w} \]

\begin{align*}
&z = -1 & t/w = 1/9 & 1/w = 1/9 \\
y = -1 & t/w = .5/9 & 1/w = 5/9 \\
w = 1 & t/w = 0 & 1/w = 1 \\
t = 0 & & & &
\end{align*}

(0,0,0)