The WebGL Companion

book proposal for Taylor & Francis Group philiprideout@gmail.com

Summary

The WebGL Companion guides readers through an essential set of rendering techniques and 3D interaction techniques, showcasing a set of small-but-complete web apps (recipes) at the end of each chapter, with diagrams and screenshots printed in full color. This book is not only the authoritative book on WebGL, it also serves as documentation for the giza library, developed over the course of the book.

About the Author

Philip Rideout has worked in the field of real-time graphics for over ten years, having played roles at several pioneering graphics companies, including Intergraph, NVIDIA, and Pixar. He is the sole author of *iPhone 3D Programming* (O'Reilly Media), and a contributing author of *GPU Pro 2* (A K Peters) and *OpenGL Insights* (CRC Press).

Tentative Outline

In the following outline, some section headings are colored green; these are tutorial-style samples that demonstrate the techniques discussed in the chapter.

Contents

1	Preliminaries	6
	1.1 A Brief History of *GL	6
	Gives an account of WebGL's ancestry (OpenGL, OpenGL ES), motivation	on,
	and rapid growth. Also briefly mentions impediments at the time of writing	ng,
	such as security concerns and IE support.	
	1.2 Building Giza: Literate Programming	6
	Describes our coding convention and the giza library that is developed or	ver
	the course of the book.	
	1.3 The Assembly Line Metaphor	6
	High-level overview of the WebGL rendering pipeline.	
	1.4 The Canvas Element	6
	Explains the width and height attributes, how to handle retina displays.	
	1.5 Animation Timing	6
	How to periodically trigger a draw events.	
	1.6 Recipe 1: Strobe Light	6
	The simplest possible WebGL application; animates a solid color with clear	ar.
2	Vertex Shading and Transforms	7
-	2.1 Vector Algebra with Javascript	7
	This sections walks through giza's implementation of vector and matrix class	ses.
	Rotation, translation, and scale are given a very brief treatment.	
	2.2 Life of a Vertex	7
	Describes model, view, and projection transforms.	
	2.3 Shading Language Basics	7
	Explains uniforms, attributes, and varyings. Walks through trivial main fur	nc-
	tiosn for vertex and fragment shaders.	
	2.4 Line Drawing	7
	Explains the LINES primitive and drawElements.	
	2.5 Typed Arrays, Vertex Attributes and VBO's	7
	Shows how hetergeneous data (eg, colors and positions) can be interleaved a	nd
	submitted to WebGL.	
	2.6 Recipe 2: Color Graph	7
	Animated wireframe graph of the sinc function; illustrates performance diff	er-
	ences between Javascript-side computation and shader-side computation.	
3	Downloading and Applying Artistic Content	8
	3.1 Texture Coordinates	8

CONTENTS CONTENTS

	Quick overview of texture coordinates and wrap modes. For an example, show	VS
	how to apply a section of the Mona Lisa to a quad.	
	3.2 Texture Filtering	8
	Overview of minification, magnification, and mipmapping; uses small pixel a	rt
	to illustrate the effects of filtering.	
	3.3 Parametric Surfaces	8
	Procedural generation of simple geometry.	
	3.4 Loading Mesh Data with XMLHttpRequest	8
	Implements Giza's download functionality; also mentions webgl-loader.	
	3.5 Recipe 3: Planet Mars	8
	Downloads a sphere mesh and a Mars texture; also demonstrates	
	WEBGL_compressed_texture_s3tc.	
4	Rendering and Lighting Solid Objects	9
	4.1 Face Orientation	ç
	Explains polygon winding, GL_CULL_FACE (used in the Planet Mars recipe) ar	10
	gl_FrontFacing	
	4.2 Dealing with Depth	ç
	Explains the depth buffer and how depth artifacts can arise.	
	4.3 Surface Normals	ç
	Extends the "Parametric Surfaces" sample to compute surface normals.	
	4.4 Lambertian Reflection	ç
	Illustrates a simple ambient-diffuse-specular lighting model.	
	4.5 Recipe 4: Cel Shading	ç
	Applying standard lighting, then snapping the color gradient to a few colo	rs
	for cartoon-style rendering.	
5	Framebuffer Effects, Part I	.0
	5.1 Alpha Blending	(
	Explains the different blend modes; also discusses back-to-front sorting ar	10
	screen-door transparency with discard.	
	5.2 Framebuffer Objects	(
	How to create offscreen render targets.	
	5.3 Floating Point Textures	(
	Explains unclamped colors (OES_texture_float) and how they can be used for	O1
	general-purpose computation.	
	5.4 Subsurface Scattering	(
	Rendering transluscent marble with floating point textures.	
	5.5 Gaussian Blur	(
	Optimal filtering with minimal taps.	
	5.6 Stencil Buffer	(
	Brief overview of stencil and how it can be used for CSG and shadows – almo	S1
	mentions WEBGL_depth_texture	
	5.7 Recipe 5: Mughal Window	
	Illustrates stenciled fake reflection, a depth-based glass effect and a jaali scree	er
	backdrop with HDR bloom.	

CONTENTS CONTENTS

6	Framebuffer Effects, Part II	11
	6.1 Distance Blur	11
	Depth of field via post-processing; also mentions a jitter-based technique. 6.2 Ambient Occlusion	11
	Screen-space ambient occlusion.	
	6.3 Shadow Maps	11
	Old-school PCF shadow mapping.	
	6.4 Heat Shimmer	11
	Using the fragment shader to create a heat wave effect.	
	6.5 Recipe 6: Desert Scene	11
	Rotates the camera around a static desert scene that uses all the technic	ques
	discussed in this chapter.	
7	Texture Tricks, Part I	12
	7.1 Point Sprites	12
	Show how to use point sprites and vary their size from the vertex shader.	
	7.2 Derivatives Extension	12
	Shows how fragment shaders can smooth the edges of procedural patterns us	sing
	OES_standard_derivatives.	
	7.3 Recipe 7: Tube Sparks	12
	Flies the viewer through a tube with stripe patterns and embers falling to	the
	floor. Embers are animated in the vertex shader and rendered with addi	tive
	blending.	
8	Texture Tricks, Part II	13
	8.1 Reflection and Refraction with Cubemaps	13
	Classic, simple use of cubemaps.	
	8.2 Normal Mapping	13
	Bumps and dimples in tangent space.	4.0
	8.3 Using the WebCam	13
	Capturing video in real time and using it as a WebGL texture.	10
	8.4 Anisotropic Filtering	13
	High-quality rendering of nearly edge-on geometry using	
	EXT_texture_filter_anisotropic. 8.5 Recipe 8: Movie Theater	13
	Displays a dimpled glass ball that refracts the webcam image.	10
9	Interaction Techniques, Part I	14
	9.1 Trackball Rotation	14
	Classic mouse-driven rotation.	
	9.2 Selection Buffer	14
	Render object IDs into a FBO.	
	9.3 Inverse Kinematics	
	Shows how to animate an articulated skeleton. This is a high-level overv	riew
	only, since giza's IK implementation is quite math-heavy.	1.4
	9.4 Vertex Skinning	14
	Render soft joints by blending multiple vertex transformations.	1 4
	9.5 Recipe 9: Dancing Manikin	14

CONTENTS CONTENTS

Users can interact with a stick figure by dragging its hands and feet.

10	Interaction Techniques, Part II	15
	10.1 View Cube	15
	Move the camera by clicking hotspots on a cube.	
	10.2 Manipulators	15
	Interactive handles for positioning objects.	
	10.3 Überlight	15
	Spotlight effects with superellipsoid shapes.	
	10.4 Recipe 10: Stage Dressing	15
	Users can place objects and spotlights into a scene.	
11	Beyond Giza: Related Libraries 11.1 three.js	
	making it easy to create simple demos. It also provides support for non-Web	
	rendering (eg, canvas or SVG rendering).	, GL
	11.2 glMatrix	16
	Fast vector math from Brandon Jones.	
	11.3 danser.js	16
	Create music-based animation.	
	11.4 tween.js	16
	Robert Penner's animation equations.	

Preliminaries

- 1.1 A Brief History of *GL
- 1.2 Building Giza: Literate Programming
- 1.3 The Assembly Line Metaphor
- 1.4 The Canvas Element
- 1.5 Animation Timing
- 1.6 Recipe 1: Strobe Light

Vertex Shading and Transforms

- 2.1 Vector Algebra with Javascript
- 2.2 Life of a Vertex
- 2.3 Shading Language Basics
- 2.4 Line Drawing
- 2.5 Typed Arrays, Vertex Attributes and VBO's
- 2.6 Recipe 2: Color Graph

Downloading and Applying Artistic Content

- 3.1 Texture Coordinates
- 3.2 Texture Filtering
- 3.3 Parametric Surfaces
- 3.4 Loading Mesh Data with XMLHttpRequest
- 3.5 Recipe 3: Planet Mars

Rendering and Lighting Solid Objects

- 4.1 Face Orientation
- 4.2 Dealing with Depth
- 4.3 Surface Normals
- 4.4 Lambertian Reflection
- 4.5 Recipe 4: Cel Shading

Framebuffer Effects, Part I

- 5.1 Alpha Blending
- 5.2 Framebuffer Objects
- 5.3 Floating Point Textures
- 5.4 Subsurface Scattering
- 5.5 Gaussian Blur
- 5.6 Stencil Buffer
- 5.7 Recipe 5: Mughal Window

Framebuffer Effects, Part II

- 6.1 Distance Blur
- 6.2 Ambient Occlusion
- 6.3 Shadow Maps
- 6.4 Heat Shimmer
- 6.5 Recipe 6: Desert Scene

Texture Tricks, Part I

- 7.1 Point Sprites
- 7.2 Derivatives Extension
- 7.3 Recipe 7: Tube Sparks

Texture Tricks, Part II

- 8.1 Reflection and Refraction with Cubemaps
- 8.2 Normal Mapping
- 8.3 Using the WebCam
- 8.4 Anisotropic Filtering
- 8.5 Recipe 8: Movie Theater

Interaction Techniques, Part I

- 9.1 Trackball Rotation
- 9.2 Selection Buffer
- 9.3 Inverse Kinematics
- 9.4 Vertex Skinning
- 9.5 Recipe 9: Dancing Manikin

Interaction Techniques, Part II

- 10.1 View Cube
- 10.2 Manipulators
- 10.3 Überlight
- 10.4 Recipe 10: Stage Dressing

Beyond Giza: Related Libraries

- 11.1 three.js
- 11.2 glMatrix
- 11.3 danser.js
- 11.4 tween.js