Oculus Rift
IN ACTION

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FOREWORD BY Philip Rosedale

MANNING

Oculus Rift in Action

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Dedication

For Leo and Kesten

B.D.

For Sam, Ted, and Max

K.B.

For Antonia

A.B.

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Foreword

Two amazing advances from the smartphone arms race have come together to create the head-mounted display (HMD): light, cheap, high-resolution displays, and a new generation of super accurate and fast-motion sensor chips. Rather than display information or graphics on the surface in front of you, these displays rest on your head and update quickly enough to convince you that what you're seeing is as real as the place you left behind. Although HMDs have existed for decades, they'v never worked well enough to be more than aspirational prototypes destined for science museums. Bu with the Oculus Rift, the sensation of having a stable 3D world surround you as you move your head a game-changing shift from peering into a 3D space through a desktop screen or handheld device.

Within the next 10 years, improved devices like the Oculus Rift will replace many of the screens we surround ourselves with today as their resolution scales to eclipse our TVs and monitors. Ultimately, we will use them to replace as much or as little of the world around us as we choose, with digital content that is indistinguishable from reality. The impact of these first-generation devices on gaming and virtual worlds will be incredible.

But along this road there are many changes to UI, experience, and computing paradigms that you'll need to understand, and the authors of *Oculus Rift in Action* take you on a comprehensive overview o them. As a developer getting started with the Rift, you get a complete walkthrough of connecting to and rendering to the device.

Beyond this, you'll learn the important differences raised by such devices: How do you type without keyboard? If Microsoft and the Mac revolutionized computing by putting things in windows, what wi we do in an HMD? Why do we get sick using these devices, and how can we fix that? This book gives a complete and grounded overview of the specific technology and operation of the Oculus Rift, as we as the big picture topics that you'll need to survive in a new world without monitors. Finally, it dives into the new and complex design factors around how to correctly control things, navigate, and build i the virtual world as an "avatar" given the capabilities and limitations of these new input devices for the head and body.

PHILIP ROSEDALE CREATOR OF SECOND LIFE

Preface

No matter what people have, they always dream of something more: more power, more influence, more knowledge, but perhaps most importantly, more possibilities. This drive is part of the human condition and is responsible for our going from the Wright brothers to Apollo 11 in a single century.

If you want the future, you have to build it yourself. But the future I want, the one I think many of us want, isn't something we can each build on our own, if only for lack of time and resources.

We've written this book to lend a hand to those who want to help build the future in virtual reality (VR) but perhaps don't know where to start.

BRAD DAVIS SEATTLE, WA

Virtual reality was not something I'd expected to ever get involved in. As fun as it was to daydream about having my own holodeck to simulate an environment as if I were really there, the technology never seemed to be there, and so I pursued other work. My coauthor Brad, though, paid more attentio and spotted the Oculus Rift on Kickstarter. As an early backer, he was very enthusiastic about its potential to create truly commercial VR. Brad made it sound interesting enough that I ordered my ow DK1 development kit. While I waited the two months for it to ship, I researched what others were doing and watched YouTube videos. When it finally arrived, nothing I'd seen or read could do justice to the actual experience.

Like many people, my first experience was the *Oculus World* (also known as *Tuscany)* demo. In it yo can meander around an old Tuscan villa. The graphics aren't spectacular, and the low resolution on th DK1 made it appear as though I was looking through a screen door, but those things didn't matter on little bit when I tilted my head to look up and the scene changed to match where I was looking. I was overcome by giggly delight, looking up at the wooden rafters of the house. When I moved my avatar outside, I looked up to see the sky. This was immersion as I'd never felt before, and it was amazing.

That first experience sent my mind racing with thoughts about the potential of VR. I could see the Ri being used for gaming, virtual tourism, storytelling, and science. But to me, education was the most interesting, and it's where I first saw the Rift's potential turned into reality. When my younger son came home from school telling me he was learning about Paris and the Eiffel Tower for multicultura day, I downloaded the *Tower Eiffel* demo by Didier Thery and let him see what it's like to stand beneath the tower's impressive metal arches.

When my boys and I watched the *Nova* television series with Neil deGrasse Tyson, I downloaded *Titans of Space* by DrashVR so that they could take their own trip through the solar system and feel how grand and vast the universe truly is. They, of course, now want to visit Paris and work for NASA and I'm truly excited to see what the future brings.

KAREN BRYLA TINTON FALLS, NJ

A long time ago, I noticed that people are always looking *around* but they rarely look *up*. I guess it's because there's not usually a lot of stuff overhead to see. I thought that if I could help people learn to

look up as often as they look around, then we would go to space sooner, because people would look u at the stars and the moon and think, "Hey, let's go check that out." And I want to go to the moon. Not just as a one-off thing where you leave your lander behind when you go home—I want humans to hav real cities in space, with shops and streets and hot dog stands.

So I got into computer graphics because of space. I figured that the best way I can get there (short of becoming an astronaut, which seems too much like real work) is to make virtual reality happen. I wa to put people into virtual worlds that train them to expect more from the real one. In VR, there's no reason for the world not to stretch as far above you as it does to either side. In VR, we can make worlds where all the best stuff is overhead, and you'll always have to look up to find it. After a while looking up will get to be a habit.

And if we can teach people to look up, then someday I'll eat a hot dog on the moon.

ALEX BENTON LONDON, ENGLAND

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ALEX BENTON wishes to thank his amazing wife, Dr. Antonia Benton, for her constant support and encouragement, and Verna Coulson for her unwavering enthusiasm.

About this Book

Oculus Rift in Action is designed to help you create comfortable and usable virtual reality (VR) applications that run on the Oculus Rift head-mounted display.

How this book is organized

This book is organized into five parts:

- ***Part 1*: Getting started—** Part 1 introduces you to VR and the Oculus Rift hardware. We'll cove why you'd want to support the Rift in your software and how the Rift works.
- ***Part 2*: Using the Oculus C API—** Part 2 covers how to develop Rift applications using the Oculus C API. Whether you're looking to write applications using the API directly, to integrate Rift support into your own game engine, or simply to better understand how Rift support works your game engine of choice (Unity, for example), this part of the book is for you.
- ***Part 3*: Using Unity—** Part 3 covers how to use Unity, a popular development IDE and 3D graphics engine, to develop Rift applications. Unity is a great way to jump-start creating 3D games as it handles just about every aspect of game development, such as graphics, audio, physics, interaction and networking. With the Unity integration package from Oculus, you can quickly get your application running on the Rift. If you want to use Unity for your VR development, you'll find much value in part 3.
- ***Part 4*: The VR user experience—** In part 4, we turn our attention to the VR experience. No matter how you've created your VR application, you're going to want to design your applicatio so that it's comfortable and easy to use in the VR environment. In this part of the book we look the challenges of creating a usable UI for the VR environment. We cover some of the common pitfalls of designing a UI for VR along with the latest research into the key components to an immersive virtual experience. We also take a look at what you can do to maximize user comfor including guidelines and examples of how to mitigate motion sickness triggers and other causes of physical discomfort such as fatigue and eyestrain.
- ***Part 5*: Advanced Rift integrations—** In the final chapters, we provide information and example for work that goes beyond the core integration of the Rift APIs. Here you'll learn to work with the Oculus C API using Java or Python, along with the basics of how to use the C APIs with any language. We also provide an example of creating a complete VR experience by building a VR version of an existing web application for use on the Rift. Finally, we cover integrating addition inputs into Rift apps, using modern hardware like web cameras and the Leap Motion.

Wondering where to start? Every reader should start with part 1 because it introduces you to the hardware and to the virtual reality concepts we'll be using throughout the book. After that, where you go depends on how you plan to develop your application. C/C++ developers will want to turn to part 2 and Unity developers to part 3. No matter how you're going to develop, your next stop should be part 4, to learn how to ensure your users get the most out of your application. When you're ready to move on to advanced Rift integrations and see a full-fledged VR app in action, turn to part 5.

What this book doesn’t do

This book doesn’t cover how to use OpenGL, nor does it discuss the basics of 3D programming. It als
doesn’t cover C or C++ or how to use any particular development environment. If you’re unfamiliar
with these topics, you’ll find some good references listed in appendix C.

Code conventions and downloads

All source code in the book is in a `fixed-width font` like this, which sets it off from the surrounding text. In many listings, the code is annotated to point out the key concepts, and numbered bullets are sometimes used in the text to provide additional information about the code.

We have tried to format the code so that it fits within the available page space in the book by adding line breaks and using indentation carefully. Sometimes, however, very long lines include line-continuation markers. **`Bold fixed-width font`** like this in listings indicates new code.

Source code for all the working examples in this book is available online in our GitHub repository at github.com/OculusRiftInAction/OculusRiftInAction.

If you're using Unity (part 3 of this book), you don't need to download the entire example repository The scripts and the example scenes for part 3 are in /examples/unity.

If you're using the C API (part 2 of this book), details of how to download and build the C++ and Jav example applications are discussed next.