

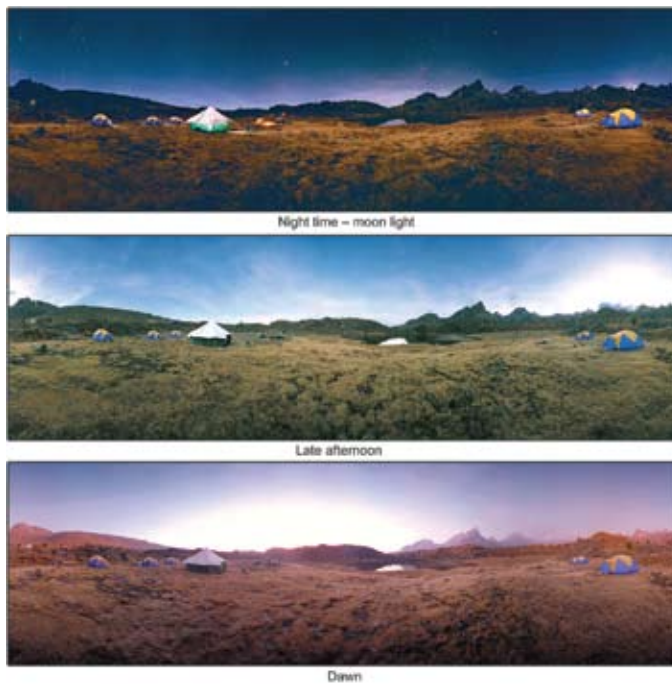
# Virtual Reality Photography

BY PETER SKINNER

SCOTT HIGHTON



A resolution comparison between digital camera sensors. Lower resolution provides less image detail.



Simply changing the time of day in which you shoot a naturally lit outdoor scene can result in radically different lighting and overall look, as in these 360° panoramic examples of a high climbing camp on Mt. Kenya in Africa.

While the global financial meltdown may have eroded many photographers' assignment work, San Francisco virtual reality photography pioneer Scott Highton took advantage of this time on his hands to produce a veritable encyclopedia on virtual reality photography—*Virtual Reality Photography: Creating Panoramic and Object Images*. And it's a book that not only addresses every conceivable creative or technical question about VR photography, it will undoubtedly encourage other photographers to consider adding this service to their studio.

In every sense of the word this is the bible of VR photography, and its 24 chapters and 300-plus pages are packed with a smorgasbord of information ranging from the basics of photography, to highly technical and complex projects, applications of VR photography and marketing and business practices. Brilliant examples of VR photography, case studies, diagrams and other illustrations explain and enhance the techniques Highton has mastered during his 30-year career as a photographer and cinematographer.

Rick Smolan, co-creator of the *Day in the Life* and *America 24/7* series, who penned the foreword to Highton's book, describes it as the ideal guide for navigating one's way through the environment of VR photography. "With this seminal book, Scott Highton, one of the pioneers of virtual reality photography, provides a foundation for both photographers and multimedia designers seeking to learn the techniques of effective visual story telling via interactive imaging. I can't think of a better guide to accompany you on your journey through this fascinating medium," Smolan says.

## An Explosive Growth

And while VR photography requires the practitioner to have the skills and artistry of a visual storyteller and the technical competence to master the cameras, lenses, software and post-production techniques involved, the possibilities for VR photography are seemingly endless—from niche applications to mass markets. So any contemporary photographer working comfortably in this digital age should be able to harness the potential of VR photography in some way. As Highton points out, the proliferation of personal computing has made VR displays of objects and environments a mainstream technology. "Virtual reality experiences are no longer limited to military and high-end corporate budgets. Today there is an explosive growth in the use of VR imagery on the World Wide Web and in electronic consumer publishing," Highton says.

Most people will have experienced VR imagery in some context—such as previewing a travel destination, touring real estate for sale, sitting inside and "driving" a car or learning how to use a tool. The

use of photography for these VR applications has been dubbed "immersive imaging," because the viewer is effectively immersed into a product or scene. "Rather than simply looking at a printed brochure of a new car, a prospective buyer can actually view the car from any angle or look around the interior from a virtual perspective within the vehicle," Highton says.

## Complexities

VR photography is far more complex than traditional still photography, due in no small part to the volume of images and content required. In addition to the photography, a VR project invariably involves many elements such as graphics, sound and links to other supporting supplemental information. As Highton says, there is really no such thing as a small interactive multimedia project and interactivity is provided only by giving viewers multiple options to choose from as they navigate through each project.

VR photography has been around for quite some time, but in its formative years the technology required prohibitively expensive camera and computer systems. But then, in 1994, Apple Inc., introduced QuickTime VR (QTVR), the first significant consumer-level technology for creating and displaying VR images. And VR pioneers like Highton were quick to capitalize on this groundbreaking innovation.

In fact, Highton was the first outside photographer hired by Apple to test and work with QTVR technology during its development in 1994. That year he photographed the first commercial QTVR project for the original Apple Company Store, and the following year he served in a similar capacity for the now defunct IPIX Corporation—at the time known as TeleRobotics International. Numerous other similar projects followed, and before long Highton became one of the "go-to guys" of VR photography.

There's no question that QTVR was a boon to the field, and while there are other VR presentation formats currently available, according to Highton, they are for the most part very similar in appearance and function to QTVR. It should be noted that QTVR offers two distinct interactive "movie" types. The first, a panorama movie, is photographed from a central position looking outward, creating a 360-degree panoramic view. The other is known as an object movie that provides a series of incremental views looking inward at an object, thus allowing viewers to examine an object from any angle, effectively turning that product around or tilting it up and down with their computer mouse.

Those two movie types require different treatment in planning and execution. Highton, not simply content with sticking to what might be perceived as run-of-the-mill VR projects using either movie type, pushed the limits of the technology in challenging environments. He was the first to shoot both QTVR and IPIX panoramas underwater, and has photographed on assignment throughout the world, including: aerial, extreme, and remote locations. In his efforts to push the creative envelope, he has developed a number of custom camera mounts for positioning his cameras in unique locations, and has also worked with several commercial pan head manufacturers to help refine their designs. He trained as a machinist and metal fabricator in his spare time in order to better pursue these efforts.

As with most photographers, a book had been floating around in Highton's mind for a long time, and that idea, first planted by another well known San Francisco-photographer and author, Mikkel Aaland, really took hold when Highton's steady flow of assignments diminished with the recent economic downturn.

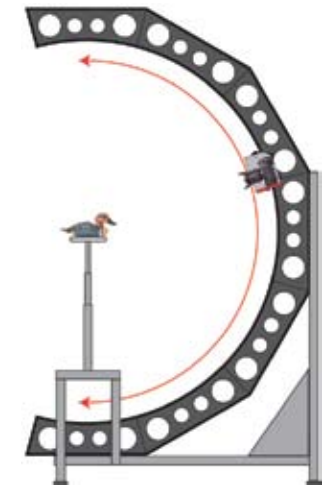


Low ISO

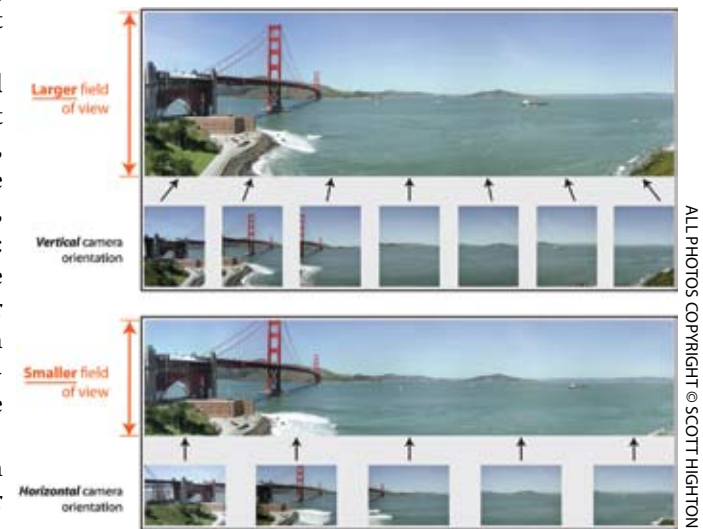
High ISO



Digital cameras with adjustable ISO settings show similar tradeoffs to film performance. Higher ISOs provide greater light sensitivity, but with increased noise.



A sample of a fixed arc object rig (made by Kaidan) used for shooting VR object photo sequences.



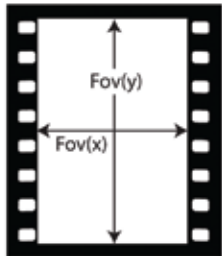
Portrait (vertical) orientation of the camera is preferred when shooting stitched panoramic image sequences as this increases the vertical field of view of an assembled panorama.





Wider focal lengths provide greater vertical coverage in stitched panoramas, and require fewer source images.

### Fields of View (Fov): 35mm camera and lenses



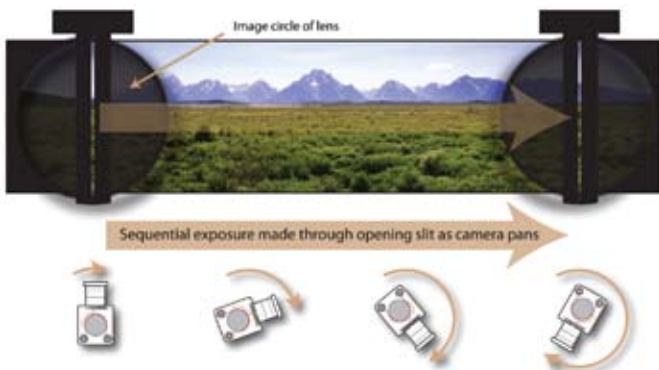
**Fov** is the Field of view provided by a lens within a 35mm film frame.

**Shots/360°** represents the minimum images needed for a 360° horizontal panorama with 1/3 (or more) overlap between images.

Focal length*	Fov(y)	Fov(x)	Shots/360°
13mm	108°	86°	6
14mm	104°	82°	6
15mm	100°	78°	8
18mm	90°	68°	8
20mm	84°	63°	9
24mm	73°	54°	10
28mm	65°	47°	12
35mm	54°	38°	15
50mm	39°	27°	18
85mm	24°	16°	36
105mm	19°	13°	40
135mm	15°	10°	60
180mm	11°	8°	72
200mm	10°	7°	72
300mm	7°	4.6°	120
400mm	5°	3.5°	180

\* Rectilinear (non-fisheye) or "corrected" lenses only

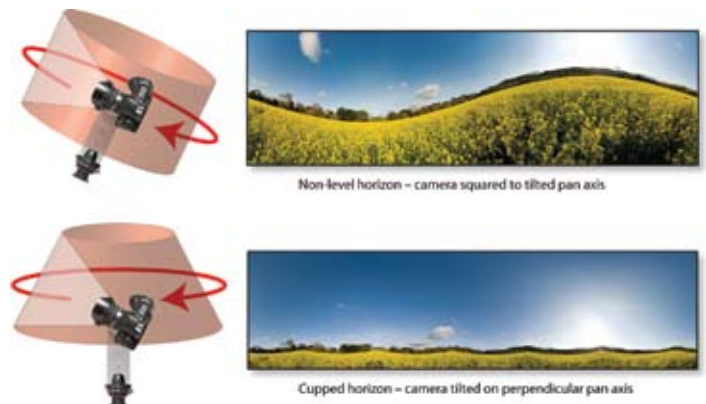
A field of view table (for 35mm and full-frame digital cameras) can be used to determine the pan angles required for sufficient overlap with different lenses between shots in a stitched panoramic shooting sequence.



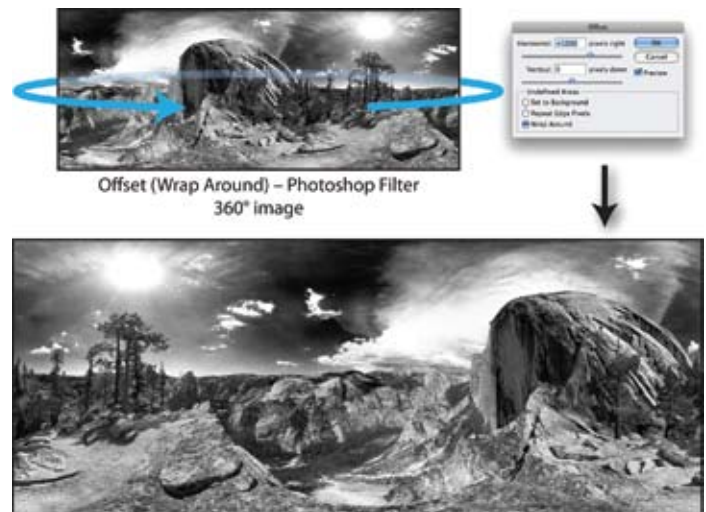
360° panoramic images can also be shot with full rotation slit scan panoramic cameras. As the camera rotates, the image is recorded in sequence on similarly moving film or on a digital sensor within the camera.



Relative image circles and frame coverage for Nikon true and full-frame fisheye lenses.



Shooting stitched panorama sequences on non-level pan axes can cause problems for some stitching applications.



Use of Photoshop's Offset filter is invaluable for adjusting composition of a 360° panoramic image for printing. Note that the ends of the panorama must match perfectly in order for this to work seamlessly.

## Artistic and Technical Skills Required

Highton emphasizes that VR photographers must have a technical understanding of the complete process, including aspects such as film/media choice, lens selection, camera alignment, lighting control, subject positioning, digital processing, post-production assembly, sequencing and end-user interfaces. He also stresses, however, that none of this is possible without the foundations of good photography, so the book's first section is dedicated to the basics.

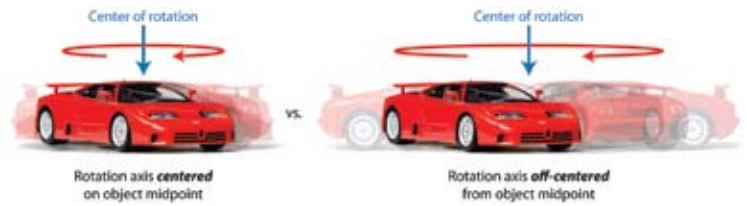
As an avid advocate and supporter of good business practices for photographers, Highton has been a frequent author and speaker at industry events. He has served as a national director for the American Society of Media Photographers (ASMP) for nearly 10 years and was the founding co-president of the Bay Area QuickTime VR Association. So, with this background, it comes as no surprise that Highton has devoted five chapters to business topics, covering subjects such as rights and value, copyright, moral rights, pricing and estimating (including a case study on estimating a VR shoot), negotiating, legal concerns, and business and marketing strategies (featuring a case study on landing the first commercial VR photo shoot) using both print and electronic media.

There's little doubt any photographer with even the slightest interest in VR photography will be impressed by the wealth of information in this book. And for anyone who has ever considered expanding their business operation to offer VR photography to their clients, the book is a timely and probably indispensable resource. For more information go to [www.vrphotography.com/bookpromo.html](http://www.vrphotography.com/bookpromo.html).

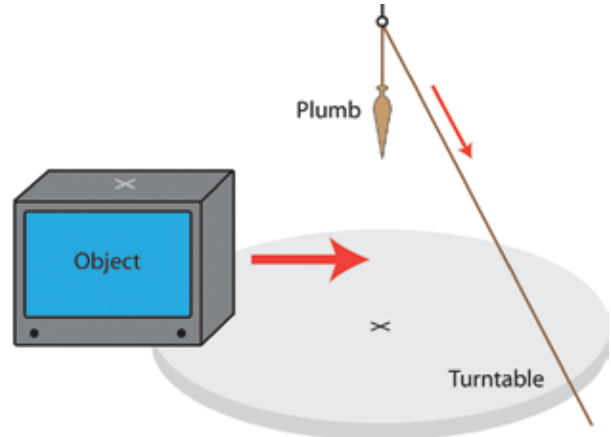
Writer/photographer Peter Skinner who is based in Queensland, Australia, has been contributing to Rangefinder since 1981. While living in the U.S., he worked with Brooks Institute in Santa Barbara, CA, as director of public relations and special projects for nearly 10 years and from 1990-2003 was communications director and publications editor for a leading trade association, the American Society of Media Photographers, ASMP. He has authored or co-authored several books with his latest offering being Sports Photography: How to Capture Action and Emotion (Allworth Press). He can be reached at [prsskinner@bigpond.com](mailto:prsskinner@bigpond.com).



For object photography, the combination of lens focal length and camera position can make significant differences in the appearance of an object. These choices by the photographer affect how the product will ultimately be perceived by viewers.

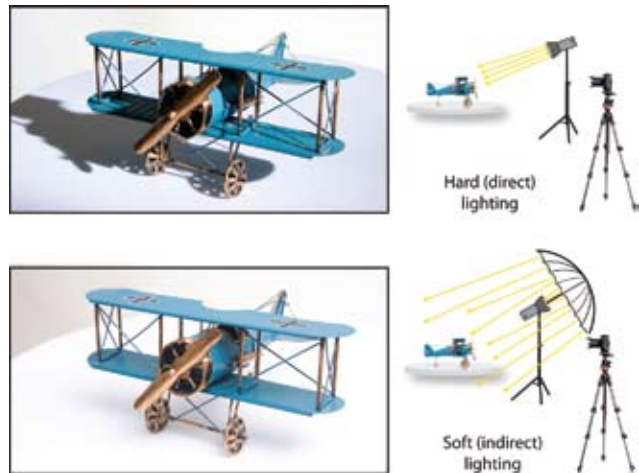


The point about which an object is rotated should be selected carefully when aligning an object on a turntable.

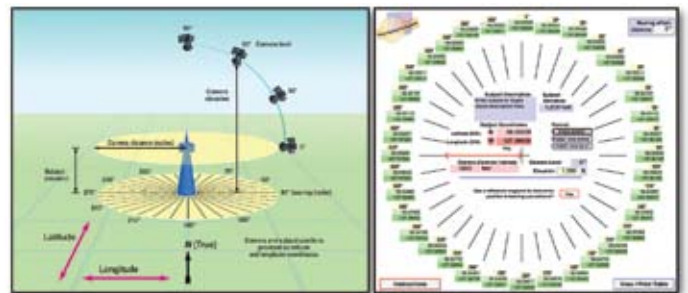


- 1) Center turntable under plumb
- 2) Raise plumb line
- 3) Position center of object under plumb

A simple process for centering an object on a turntable.



Comparison of hard vs. soft (diffused) lighting for object photography sequences.



The GPS Object Photography Calculator from [www.vrphotography.com](http://www.vrphotography.com) can be used to plot GPS coordinates for camera positioning when shooting aerial or other extremely large object movie sequences.

## Virtual Reality Photography

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Virtual reality (VR) photography is the creation of interactive visual media, primarily in the form of interactive panoramas and object movies.

Panoramas are images that allow a viewer to see an entire scene surrounding the camera. Most show a complete 360° view, and many include complete 180° vertical coverage (a 360° x 180° panorama), as well. When captured and prepared as an interactive movie, these panoramas allow a viewer to pan, tilt, and zoom in & out throughout the image on their viewing screen (a cell phone, iPad, laptop, desktop computer, dedicated kiosk, or other video system). VR panoramas essentially allow a viewer to become immersed within the image or location that was recorded by the photographer. Multiple panoramas can be linked together to allow viewers to travel virtually through an environment simply by clicking on hot spots within each panorama. Links can also be provided to other media, such as object VR movies and Web pages.

For example, if a viewer is looking at a panorama of a store interior and wants to investigate a different store department, he or she just clicks on a hot spot within the first panorama and jumps to the next department (or location) within the store. Individual products appearing on the store's shelves can be clicked, which are linked to object movies of those products so the viewer can look at the products in detail from any angle.

Object movies can be thought of as the inverse of panoramas where, rather than capturing a 360° view outward from a given point, a series of images are shot from many different angles by a camera facing inward toward the object. When assembled into an interactive object movie, these images allow a viewer to virtually rotate and view (on their screen) the object from any angle. Object movies can also include hot spot links that might direct viewers to product information, videos, panoramic VR, or even additional object movies.

Companies and organizations today utilize VR imagery primarily on their Web sites. These include the entire automotive, boating, and aviation industries, travel and hospitality, architecture, product illustration (most via object movies), the entire real estate market, and any entity wanting to show their facilities or corporate capabilities in detail. A number of hospitals have used interactive VR movies on their Web sites as recruiting tools (to show potential doctors and staff what the working environment they offer is like). Most colleges and universities are also putting such virtual tours in place for their student and faculty recruiting efforts.

There are a variety of software applications on the market that can be used to prepare such interactive VR. Most camera and lens combinations can be used to effectively capture these image sequences, although wide and ultrawide lenses are generally preferred for panoramic work. A number of basic principles and techniques must

be applied for effective shooting of both panoramic and object imagery, however.

The challenge is to make such imagery both visually appealing and effective. There is far too much technically competent but oh-so-boring VR content seen on the Web today. This is where the creative eye and skills of a competent, creative photographer become so important, and why many of the best VR photographers are already talented pros in traditional photo disciplines, who understand the importance of photography basics such as perspective, composition, and good lighting technique.

### Recommended software applications for VR:

PTGUI <http://www.ptgui.com>

VR Worx <http://www.vrtoolbox.com>

Stitcher <http://www.autodesk.com/stitcher>

