

QuickTime Virtual Reality – how to make panoramic images

by **Brian P. Lawler**

I have long been a fan of panoramic photography, and in the last 20 years have collected quite a few antique panoramic images and even taken a few with specially-built rolling-film slit-scan cameras.

Apple Computer has now satisfied my thirst for making panoramic images with its QTVR software. QTVR stands for *Quick Time Virtual Reality*.

The software has several functions: to “stitch” a

Software for QTVR

When making QTVR panoramics, you need special software.

The leader of the pack is Apple Computer’s *QuickTime VR Authoring Studio*.

In researching this paper, I found and purchased three additional Macintosh products for making panoramas. One is called *Spin*, published by



A snippet from a panoramic image of my city. This was taken as 20 images on a point-and-shoot Nikon camera (with focus locked at infinity). The focal length of the lens is 28mm., and the field of view as calculated by Apple’s QTVR software is about 70°.

series of panoramic still photos together, to “dice” the images into tiles appropriate for viewing, and finally, to build the complete interactive and navigable panoramic image.

The wonderful thing about the final QTVR images is the viewer software. When you use it, it’s as if you were inside a photographic cylinder at the viewpoint of the lens as you look around the image.

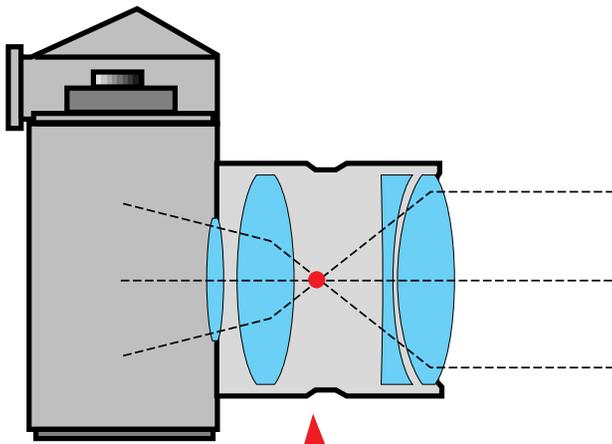
There are two big classes of QTVR images: panoramic images and *object images*. A panoramic is made by rotating the camera through a series of steps to take a complete (or incomplete) panoramic image. An *object image* is taken of an object rotated in front of a stationary camera. The result is an image which is viewed on the computer screen as if you were moving *around* the object.

This essay concentrates on the panoramic image, but much of the information here applies to object images as well. At some point I’ll expand this paper to include a discussion of objects.

Picture Works in Dublin, California. At US\$99, it’s reasonably priced, but I found its interface a bit hard to work out. I was unsuccessful in my first try to make a panorama with this software, and even after I succeeded, I came to the conclusion that the software is nice, but it takes too much operator intervention to make a successful panoramic. I was also unimpressed with the amount of blurring between frames created by *Spin*. It was too obvious to me where one frame ended and another began because of the blurs.

The second is called *Nodester* (rhymes with roadster) and it is so easy to use it’s great. In one try, with no instruction manual, I succeeded in making my panorama. A demonstration version of *Nodester* is available from Roundabout Logic at 407-327-4500. The purchase price of the software is US\$169.00.

You can download *Nodester* and make it work in a very short time. The results are great.



**Nodal Point of lens
and point-of-rotation of panoramic image**

The third product is called *PhotoVista* from Live Picture. At under \$90, it's a great deal, and its interface is very nice. For those who use the Windows operating system, both *Spin* and *PhotoVista* are also available in for Windows.

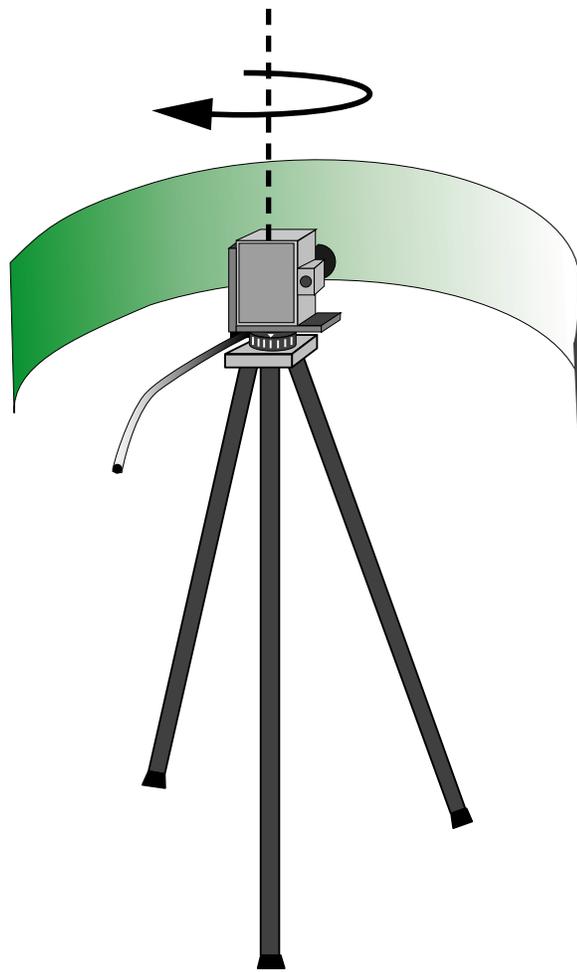
Cameras and paraphernalia

To make a QTVR panoramic image, you need a camera – and surprisingly almost any camera will work. Modestly wide angle lenses are best, and good sharp lenses are reasonably important.

Apple's manual recommends very wide angle lenses (a 15mm Nikkor is shown in their manual). It's my experience also that panoramic images taken close to the subject with moderately wide angle lenses are much better than long (or even normal) focal length lenses.

So far, my most pleasing panoramic prints have come from images made with a moderately wide 28mm lens. The aspect ratio of a 360° print from this lens is 5.7:1; the aspect ratio of a 15mm lens is much shorter, about 3.1:1. There is a huge amount of distortion in such an image.

You'll also need a tripod. A sturdy one with a rotating head is important. I have used a medium-quality tripod for my panoramas; it works fine.



With the tripod and its rotating index head, the camera is panned through a series of frames to take the entire panorama.

The next part can be tricky: an indexing camera/tripod mount. For my panoramas I have used a wooden bracket that I made in my workshop (see the drawing on page 5 for details). For my first experiments, I attached this to my tripod and then held my camera to the mount with a sturdy elastic band! It worked fine. Recent advances include a nylon machine screw to attach the camera to the mount.

The important point is that the rotation of the



The successive images (five of 20 total) taken for the panoramic image are shot in a clockwise direction. Notice that there is considerable overlap of images, and some variation in exposure. In out-of-doors scenes, the lighting is an even more critical issue. There are a number of thoughts on the issue, but the best is to avoid the direct sun if possible. This can be done by placing the camera where it will be shielded from the sun by an object. Another is to shoot in the dusk or dawn hours where there is no direct sunlight. A third is to shoot during mid-day where the sun is high overhead and will not shine directly into the camera.

camera should be around the lens' *nodal point*. It's much easier with full-size lenses to find the nodal point, but on the small camera I was using, I just *guessed* the nodal point to be approximately half way into the camera, and it has worked beautifully.

I have now made several wooden panoramic bases, and find them to be excellent alternatives to

Once you have established the number of steps to make the panorama, you can take the photos and make a test panoramic image.

Buy the new Apple QuickTime Authoring Studio software or use Nodester; both will yield good results.

QuickTime VR Authoring Studio comes as a



This is a 140° section of my Taj Mahal panoramic. This image was made with a Nikon 35mm point-and-shoot camera and 16 individual images. The quality of photos from this camera is excellent, and the image profits from the use of film (as opposed to digital imaging). Scanning was done on a Scitex SmartScan by the Apple Publishing Technology Centre in New Delhi.

the nice, but rather expensive aluminum variety on the market. I bought a spirit level at the hardware store for \$3.50 (in the hand tools section), and I put that on the wooden base to set level when making my set-ups. A ball mount would be easier.

Panoramic step-and-repeat

When taking a series of panoramic images for QTVR, you must step the rotation so that the resulting images overlap by a considerable amount. Apple's documentation recommends an overlap of between 20 and 40 percent.

With this overlap, the QTVR stitching software can find enough common points in the images that it makes the process of combining the images into a single panoramic frame simpler.

Calculating the overlap and the number of steps with the digital camera was an interesting process. I succeeded by trial-and-error since I didn't know the focal length of the DC-20's lens.

After looking around for more information, I developed the chart at right. From this chart you can look up the focal length of your lens, see the angles of Field-Of-View (FOV), and the number of steps necessary for a panoramic image. Each of these assumes a 35mm camera, mounted in a *vertical* position on the tripod.

Since the image must be shot in an even number of steps, whatever the field of view, it must be evenly divisible into the 360° rotation of the camera.

collection of panoramic and object movie making tools. You can produce panoramic images, object images (photos of objects that can be viewed from any direction on the computer screen) or "scenes" which are a combination of panoramas, object movies, still images, and other graphic information to be navigated by the viewer on-screen.

The stitching step is the most impressive part of the QuickTime VR process. The software takes the images in the order you have designated, and looks for commonalities and points that can be stitched together to make a complete image. The stitch will cause the images to be stretched and blended together into a seamless image.

The software can also sharpen the result before saving it, though I prefer to do this in Photoshop.

Focal Length	FOV Horiz.	FOV Vert.	Pan Steps
15mm	110°	72°	10
18mm	100°	66°	12
20mm	94°	62°	12
24mm	84°	55°	16
28mm	74°	49°	16
35mm	62°	41°	18
50mm	46°	30°	24

After stitching, the image is saved as a vertical panorama in a single PICT file. This is handy (except for the vertical part) because you can open it in Adobe Photoshop and retouch it if necessary, then save it again before continuing the process.

The complete flat panorama is called a *Node*.

Dicing and finishing

When the Node file is ready for the next step, the image is “diced” by the QTVR software into 24 tiles which work together to make the QTVR panorama. After dicing, the finished panorama is



This is a part of a QTVR panoramic image taken on the surface of Mars in 1997. The rover *Sojourner* can be seen in the foreground, and the rock called *Yogi* is in the upper-right. NASA and JPL have used Apple’s QTVR extensively in the Mars exploration photo imagery.

saved in a format that can be read by various player software on Mac and Windows computers (QuickTime is the preeminent time-based image format for both Windows and Mac).

Each of the panoramas I have produced is a single node image consisting of 16-20 frames taken on one level plane.

Hot Spots

QTVR panoramic images can also have what are called *Hot Spots*, these being image areas that can be used as buttons to activate other panoramic movies, still photos, sounds, and other actions.

The process of creating Hot Spots is pretty simple. When the vertical stitched PICT file is complete, a new bit-mapped single-channel image is created that has solids painted in for the Hot Spots. Then, using the QTVR authoring tools, these hot spots are assigned actions.

It’s possible then to use the hot spot in one panoramic image to activate another node or another movie to “walk” though a scene comprised of numerous QTVR panoramic images.

This is amazing technology, and it has opened my eyes to the potential for interactive panoramic images and scenes.

It requires a leap of imagination to put yourself inside the cylinder of an interactive panoramic image, but once you have experienced

it, you’ll begin to see opportunities for this kind of image everywhere. You’ll begin to see panoramically!

Sources of images

I have made panoramas now on three continents and in a few dozen locations. The results have been exciting.

I have used four different digital cameras, the Kodak DC20 and the DC50, the Nikon Coolpix 900 and the Olympus D600L. Only the Nikon camera can have its focus locked to a specific point, so thus far it is the best for this purpose.

My film-based panoramas have been made with both my point-and-shoot Nikon camera and an SLR Nikon 4004 camera on a wooden panoramic mount (see nest page).

After shooting the images on film, I have had them processed and scanned to Kodak Photo CD disc by my favorite supplier – Color 2000 in San Francisco, California.

Compared to digital camera images, film has tremendously more information, more exposure latitude and better color. In a phrase, shoot film if you have time – the results are vastly superior.

I like the Photo CD scans because they are consistent, and the positional accuracy of the frame in each scan is almost absolute. I never have to worry about the accuracy of the scan.

And, though I own a nice film scanner, the difficulty of scanning 20 or 40 images to get the files necessary for a panorama is too great. I’d rather pay the modest fee for Photo CD images to be made from my film. The results are better and more accurate than any scans I would make.

Many happy panoramics to you

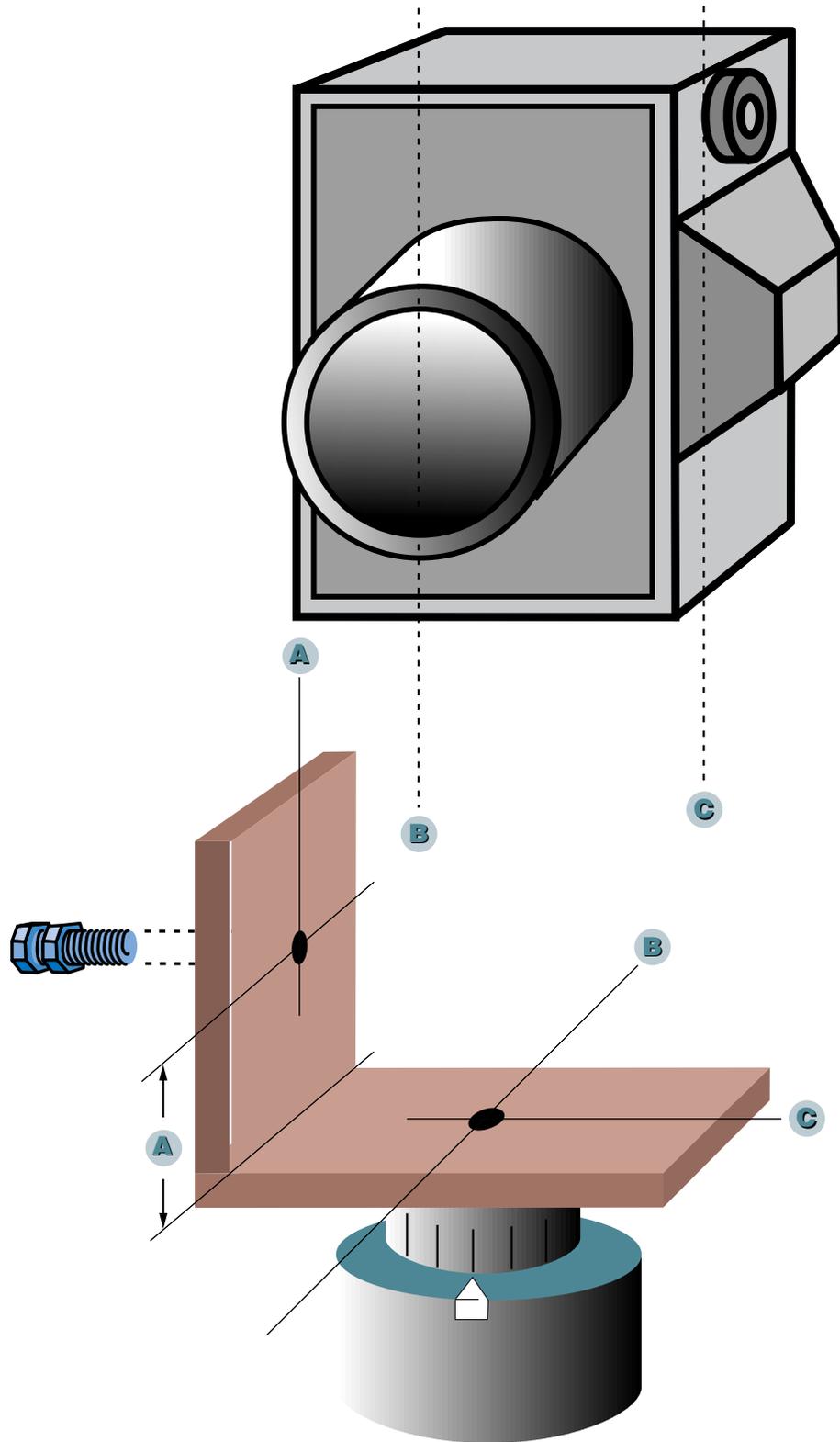
Good luck and have fun with this interesting technology!

■ This is one of a series of essays I have written on graphic arts and computer subjects. Subjects range from dot gain and halftone screens, to preparing files for the World Wide Web.

For access to the others, please direct your browser to my FTP site on the World Wide Web: www.callamer.com/bplawler/

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For more information on QTVR, also visit the Apple Computer QTVR web site: <http://www.apple.com/quicktime/qtvr/>



Build-your-own QTVR panoramic mount. My wooden panoramic mounts consist of two pieces of wood screwed together at a 90° angle. The measurements marked A are the distance from the edge and the front of the camera for the tripod screw in the camera base. B is the center point of the lens which will indicate the horizontal line of the nodal point position. C indicates the vertical dimension of the nodal point. It is determined by setting the lens at infinity, then estimating half the distance between the front of the lens and the film plane. The camera is held to the base by a 1/4-20 machine screw with an extra nut for tightening.

The rotational indicator is made by measuring the circumference of the tripod base and splitting that distance into 12, 16, 18, or 20 increments (see the chart on page 3 for details). The pointer is a piece of white drafting tape cut to a point. If your tripod has no rotational base, you can make one by cutting two additional base parts and allowing one to rotate on the other; this can be a bit more complicated, but it's not too difficult.