

Using super-high resolution panoramas (Gigapans) to document and study rock art panels

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Abstract

Relatively new robotic hardware and associated software permits capture and stitching of hundreds of telephoto high-resolution images into a large panorama file, the order of a gigabyte or more in size. These images can be examined in programs such as Photoshop or exported into formats that permit panning and zooming in a browser, such as Zoomify. Examples will be presented from the Southwestern United States.

Panoramic photography began in the middle of the nineteenth century. Images were “stitched” in the darkroom (Fig. 1). It wasn’t until the late twentieth century that Apple Computer Corporation provided a practical approach to digitally stitching images (QuickTime Virtual Reality, QTVR). This required very careful photography, and then describing the relations between images in an arcane script. The projection was limited to a cylinder. It was shortly thereafter that we started using panoramas to document rock art panels (Mark & Billo, 1999, 2006). We experimented with both panoramas (photographed from one point) and mosaics from multiple points (Fig. 2). Figure 3 is a mosaic of a long petroglyph panel on a ledge that could not be photographed from one point. Because automatic stitching software programs are designed to stitch panoramas, stitching mosaics can be quite difficult.



Fig. 1. Panoramic view from Lookout Mountain, Tennessee, USA, assembled by George N. Barnard in 1864 from three albumen prints.

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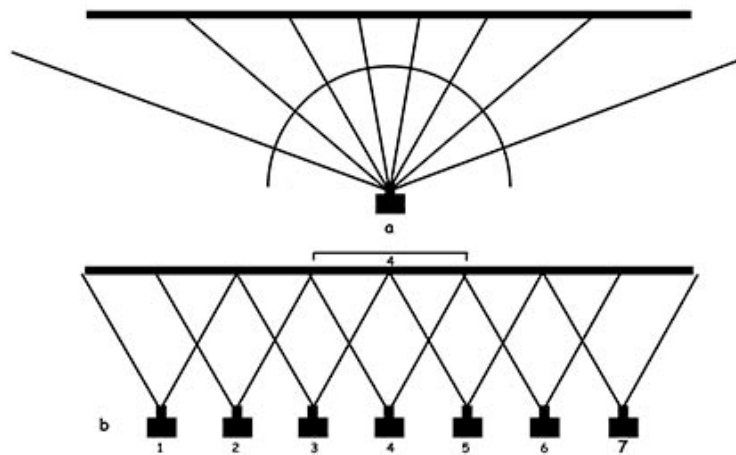


Fig. 2. a. Panorama setup with camera location fixed allowing rotation about a point within the lens. **b.** Mosaic setup with camera moved parallel to panel. In both setups, substantial overlap of adjacent images is required.



Fig. 3. Top image is mosaic of long panel (20 m) on a sloping surface above a narrow and steeply sloping ledge in northern Arizona, USA, with detailed area outlined in red enlarged and shown below.

A full-screen movie of the mosaic is at <http://www.rupestrian.com/CCCB.html>

Advances in both hardware and software came quickly. Early major software advances included stitchers that permitted graphically placing images, and supported spherical and other projections (Fig. 4).

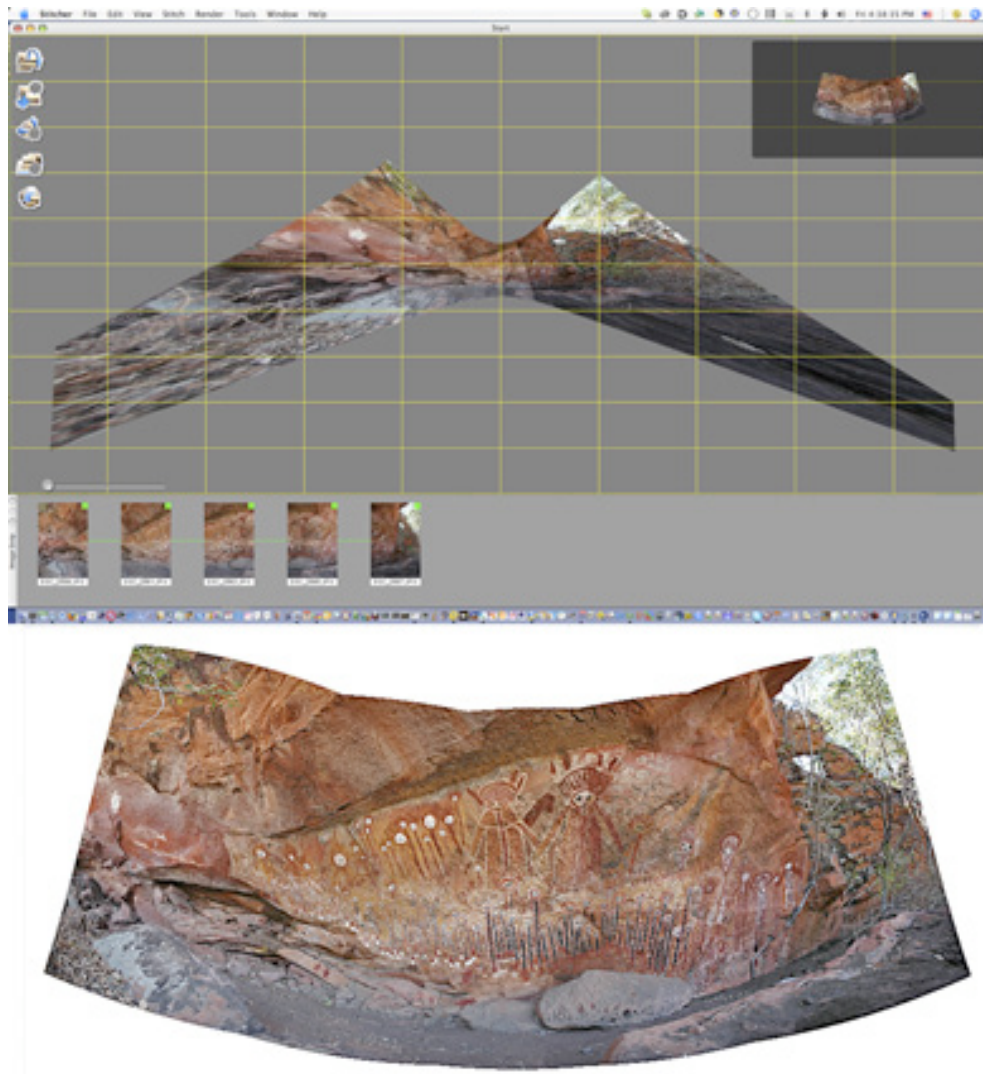


Fig. 4. Top is view of automatic assembly of images with a graphic interface, using a spherical projection. Resulting panorama at bottom is from Wardaman Country, Northern Territory, Australia.

Hardware advances included panheads which permitted rotation in precise increments about two axes (Fig. 5). Additional improvements in stitching and blending algorithms permitted more flexibility in photography, and now many panoramas are generated from handheld photographs (Fig. 6). Modern stitchers will automatically position the images, in most cases, without user intervention. Figure 7 is a high-resolution panorama with about a hundred images, stitched automatically. For a comparison of the many stitchers now available, see http://en.wikipedia.org/wiki/Comparison_of_photo_stitching_applications

The most recent advance is super high-resolution Gigapan panoramas (<http://en.wikipedia.org/wiki/Gigapan>), which permit zooming in to see minute details of elements within a larger panel. This is made possible by the use of a robotic panhead (Fig. 8), which is programmed to take a rectangular array of hundreds of overlapping telephoto images. Since their relative positions are known, stitching with

the Gigapan stitcher is efficient (Fig. 9). Figures 10 and 11 show examples of such Gigapan panoramas. These can be viewed with a graphics program, such as Photoshop, or with a browser on the Gigapan website or with Zoomify. Links to these and other Gigapan rock art panoramas can be found at <http://www.rupestrian.com/> or http://www.gigapan.org/gigapans/most_recent/?q=rmark. Be sure to select “Launch Full Screen Viewer” and allow time for screen update when zooming in.



Fig. 5. Two examples of 2-axis panheads used for spherical projection panoramas.



Fig. 6. Hand-held panorama from Chauvet Cave, France, 2000.



Fig. 7. About one hundred images were stitched automatically for this panorama from southeastern New Mexico, USA. Full file is 539MB. The image has been digitally enhanced (Mark and Billo, 2002, 2006).



Fig. 8. Gigapan robotic panhead in the field, Sears Point, Arizona, USA.
(Photo Jennifer Huang.)

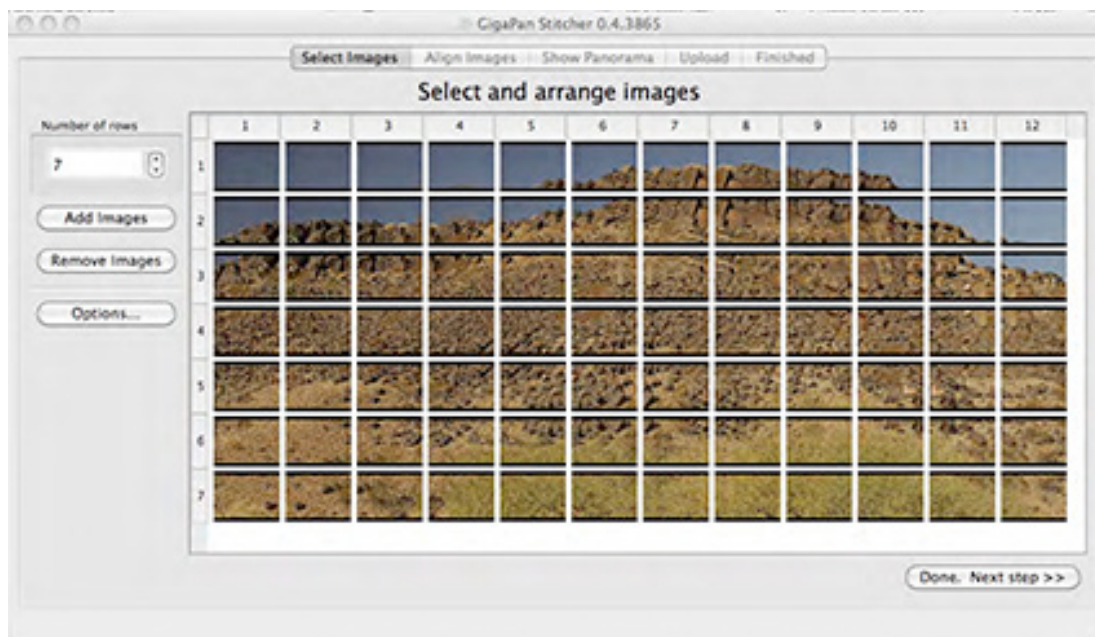


Fig. 9. Array of images in the Gigapan stitcher, prior to stitching. A full rectangular array is required. This is a very small example; arrays of several hundred images are possible. Stitching may take a few hours.



Fig. 10. Gigapan at Sear Point Arizona, USA. Red arrow indicates location of the zoomed-in petroglyph panels shown in lower image.

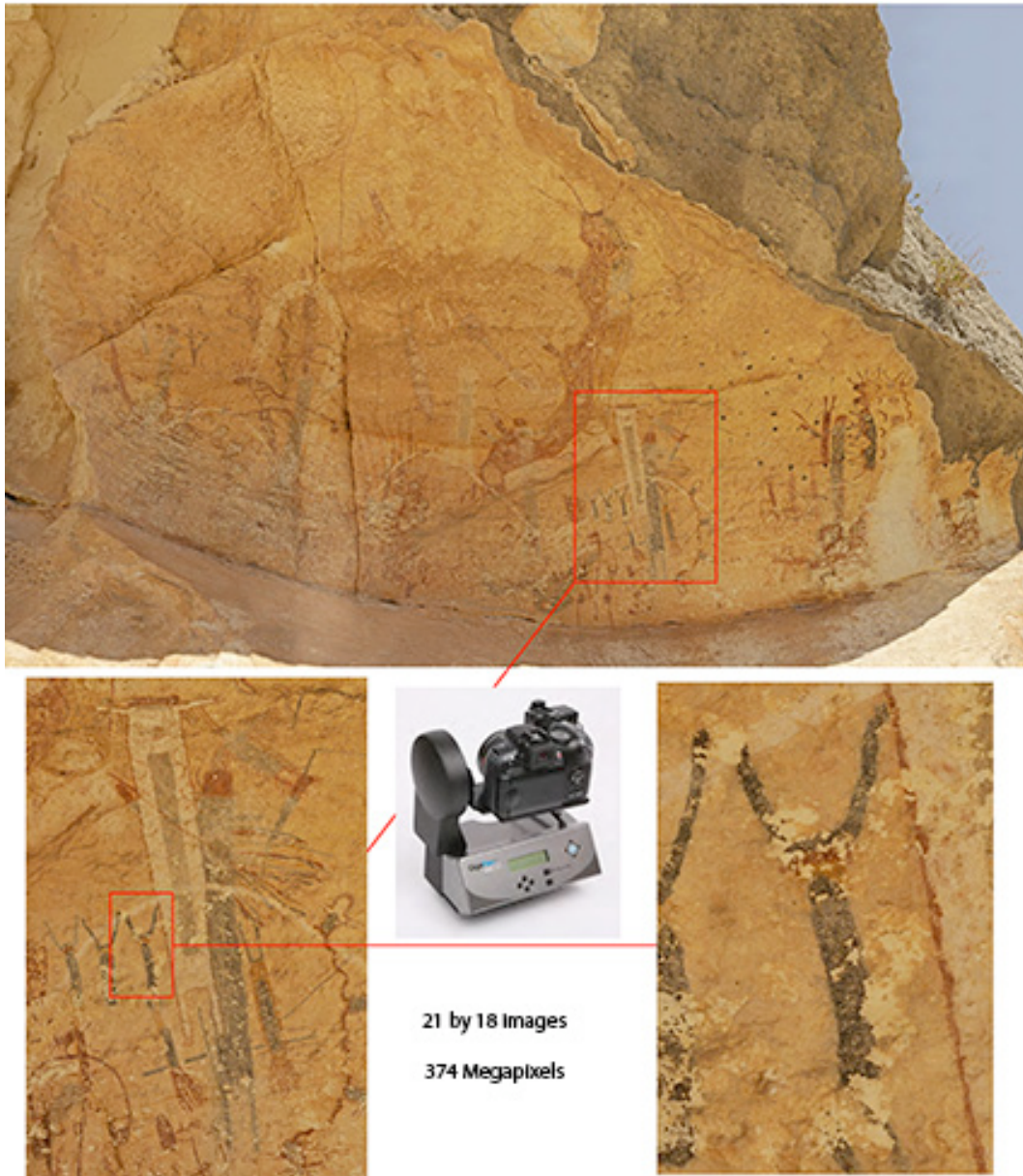


Fig. 11. White Shaman panel, south central Texas, USA, with progressive detailed views outlined in red rectangles.

Conclusion

Panoramas and mosaics are very useful in the documentation of rock art panels. Printed panoramas can be taken into the field for annotation and the marking of sample locations, such as XRF (X-Ray Fluorescence) measurements (Fig. 12). The Gigapan process provides not only systematic overlapping photographs of large areas of interest such as an entire panel, but also provides a single image with full resolution of details for digital annotation and analysis in the office.

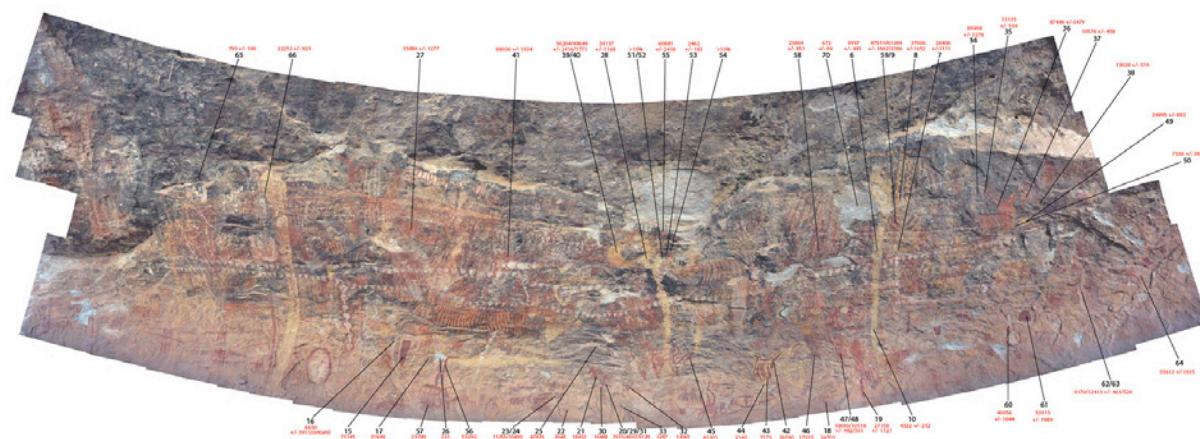


Fig. 12. XRF measurement locations were marked on a large printout of the panorama in the field, and later transferred as a layer on the digital image in the office.

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