ACADEMIA | Letters

Low-Cost Technology for Cultural Landscape Investigations with Students

Scott Walker

Introduction

Cultural heritage is situated to consider nature-society and people-environment connections that build upon humankind's interactions with landscapes (Wilcock et al. 2013). Borrowing from human geography, the concept of *place*—comprised of an intersection of context, traces, and culture (Anderson 2010)—can be informed by anthropology in terms of heritage traces and ethnographic landscape contexts (National Park Service 1995). Given the Paleoindian presence throughout the western United States many community college students in the Southwest may have the opportunity to investigate rock art sites as ethnographic landscapes. When teaching the concept of place, landscape, and traces in the community college, authentic examples through field studies can be used in order to offer examples of such ethnographic landscapes. However, what is problematic is that many community college students have neither the time nor financial resources to participate in field studies and many community college instructors have little time or resources to offer such opportunities. This is where technology can enter the picture to aid in either ethnographic landscape field study or classroom instruction related to ethnographic landscapes (Welsh et al. 2013) (see figure 1).

There is a groundswell of technological convergence bringing new capabilities to allied disciplines such as geography, anthropology, archaeology, natural resource management, and cultural heritage protection, facilitated by the significant pace of innovation across technologies that range from computer processing advancements, pad computer technology, cloud computing, open-source software, to expansions in unmanned aerial vehicles/systems. All

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Figure 1. Northwest Vista College student collecting photogrammetry field data. Source: Author.

these technologies are remarkable by themselves, however, when combined the effect is a force-multiplier that enables students to conduct project-based learning and research that was unavailable to them just a few years ago.

Fletcher et al. (2007 p. 329) reported that the "use of technology is not the end in itself, but the means of enhancing student learning." Moreover, if one perceives higher education as workforce preparation, technology literacy is an important element in the development of graduates who are employable, thus driving an external push to have students utilizing more technology during their studies.

Cost has been cited as the most common barrier to the use of technology in undergraduate fieldwork (Welsh et al. 2013). Likewise, "fear and anxiety of using technology both by students and staff [faculty]" was a close second in terms of barriers to technology use (Welsh et al. 2013, p. 409). I assert that low-cost and no-cost technology is available to support students working in the field, working in post-fieldwork data processing, and in data interpretation by students whether the data were collected by themselves in the field or by their instructors who bring the data to class for students to investigate. Low-cost/no-cost (i.e. lower stakes) technology might also reduce instructor anxiety in introducing it to students.

Given that framework, figure 2 presents some low-cost/no-cost technologies that readers might find useful in interdisciplinary cultural heritage studies and related fields. I have categorized each technology by functions of (a) data collection, then (b) data presentation from which data may be interpreted by students.

Working clockwise from the top-center, Reflective Transformation Imaging (RTI) is a

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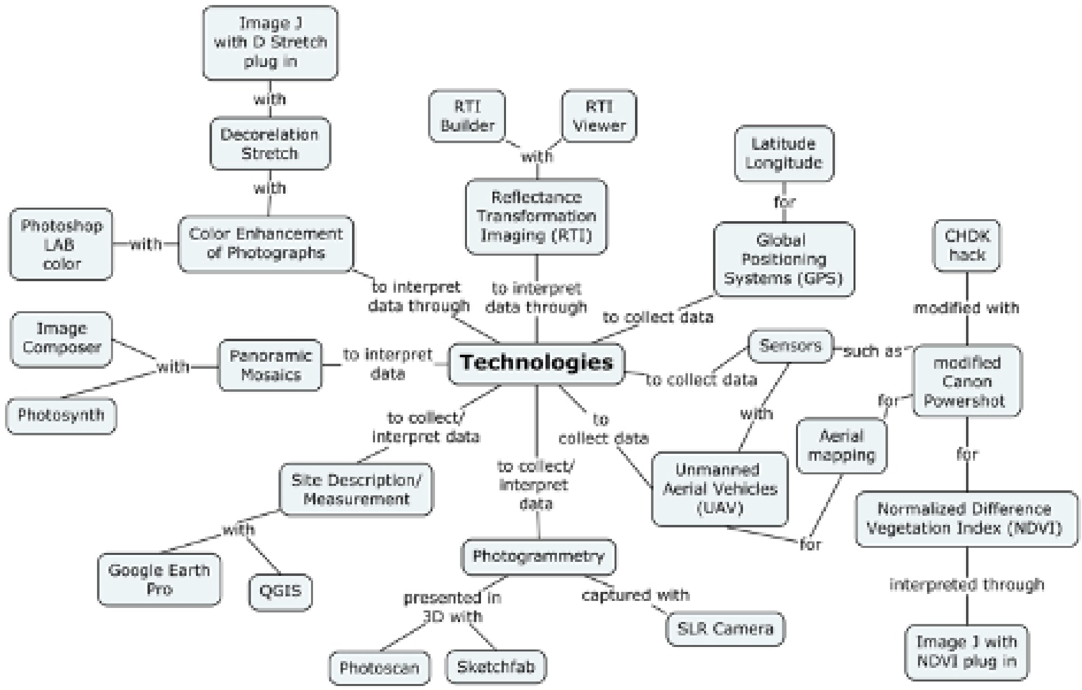

Figure 2. Low-cost/no-cost technologies for cultural heritage research. Source: Author.

photographic method that captures the surface shape and color of a subject and makes possible virtual re-lighting of the subject surface from any angle. RTI enhancements disclose surface information not normally detectable by the naked eye. The RTI Builder and RTI Viewer are free, open-source software applications and the images are captured using a standard, consumer-grade SLR camera and a flash (Cultural Heritage Imaging n.d.a).

Global Positioning System (GPS) receivers that collect latitude and longitude coordinate data via low-power radio signals from a constellation of satellites are commonplace today. Budget receivers that can download data to a computer file (unlike the GPS in a smart phone) can be purchased for as little as US$70 and can be used in conjunction with Google Earth and a variety of Geographic Information Systems (GIS) to display collected coordinate data of study sites.

Photogrammetry has become a powerful technique that can produce extremely dense and precise 3D models on a computer screen (Cultural Heritage Imaging n.d.b). One only needs a digital camera and an education license for Photoscan (Agisoft 2020). Small objects such as coins or projectile points, to larger objects such as statues or entire walls of pictographs (see figure 4), or even mid-sized building structures and study sites (see figure 3), can be

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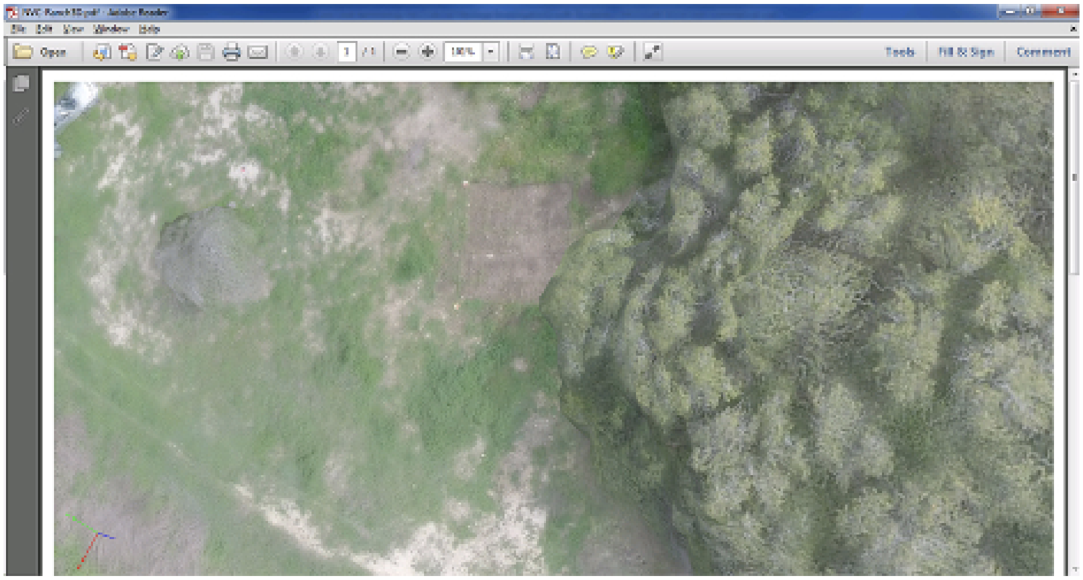

Figure 3. 3D aerial map stitched together from 56 time-interval images of Northwest Vista College's mock archaeological dig site (center). It is presented in Adobe Acrobat Reader. Note truck in top, left corner for scale. Source: Author.

rendered as virtual 3D models using photogrammetry. The results of the photographic data collected and processed can be presented through Photoscan, Adobe Acrobat Reader (free download), or online in 3D model spaces such as Sketchfab (free basic membership) (see figure 7). Sketchfab has an annotation feature through which an instructor can annotate a 3D model with specific information (see figure 6) for students to make note of. Such models can also be used in online courses where it would be important for students to virtually tour a place or view an object. Also, highly detailed two-dimensional panoramic mosaic images can be created using a variety of free online tools such as Hugin (2019) (see figure 5).

Further, students can preview and measure sites for site descriptions using Google Earth Pro (free)(see figure 8). They can also create site fly-throughs and chronological mapping analyses in Google Earth that can be saved and transferred to other computers via e-mail or download from an online class website. Moreover, QGIS, a fully functional, open-source GIS has leveled the playing field and can be used for sophisticated mapping of any given site.

Finally, Color Photographic Enhancements, commonly used in pictograph analysis work, can make visible faint elements of rock art using the DStretch plug in for ImageJ. The complex algorithms, originally created by NASA to produce false color images from satellites, are available in the ImageJ program at no cost (Harman n.d.)(see figure 9). Likewise, for those

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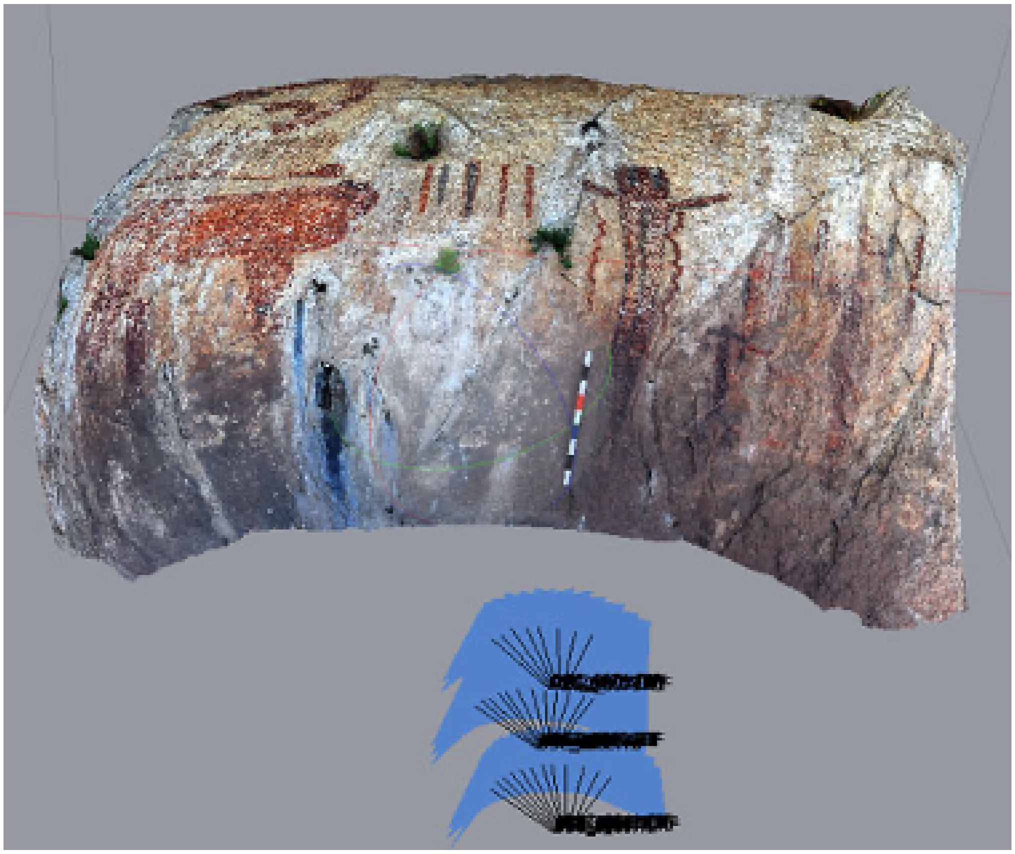

Figure 4. 3D model of the Lower Pecos "Curly Tail Panther" site in Photoscan. Over 30 images have been stitched together to render a highly detailed model that can be exported in a number of formats. Source: Chloe Walker.

who have access to Adobe Photoshop, LAB color, a free alternative color space download, is useful for enhancing subtle color differences in rock art (Mark and Billo 2002), textile, and manuscript analysis, similar to that found in ImageJ's DStretch.

I have presented a general outline of what technologies are available to those who teach cultural heritage related subjects. At this point in time cost is becoming less of a determining factor and instructor time to learn and implement new, low-risk technologies is speculatively the major hurdle to overcome. However, interested community college instructors can select a given technology and begin to explore it incrementally. My own story involves a long-time interest in photography uses for education and my personal explorations of the Lower Pecos and Trans-Pecos regions of Texas. My interest and exploration in the other technologies

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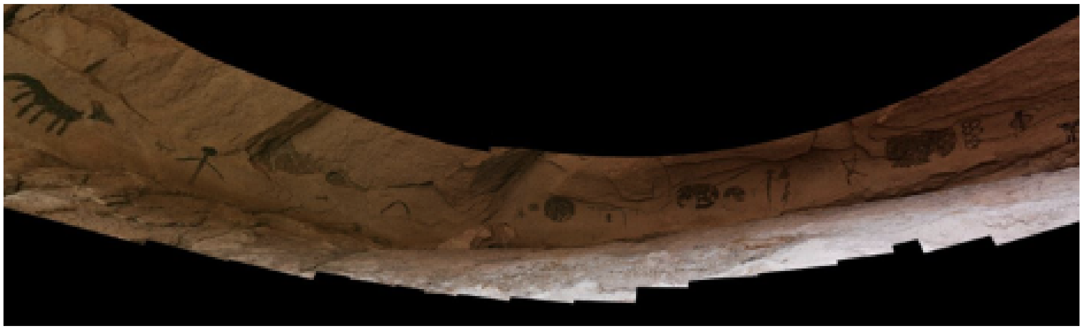

Figure 5. Highly detailed, zoomable 2D panoramic mosaic of Big Bend Bold style rock art at the Four Seasons Shelter site in Big Bend Ranch State Park. Source: Chloe Walker.

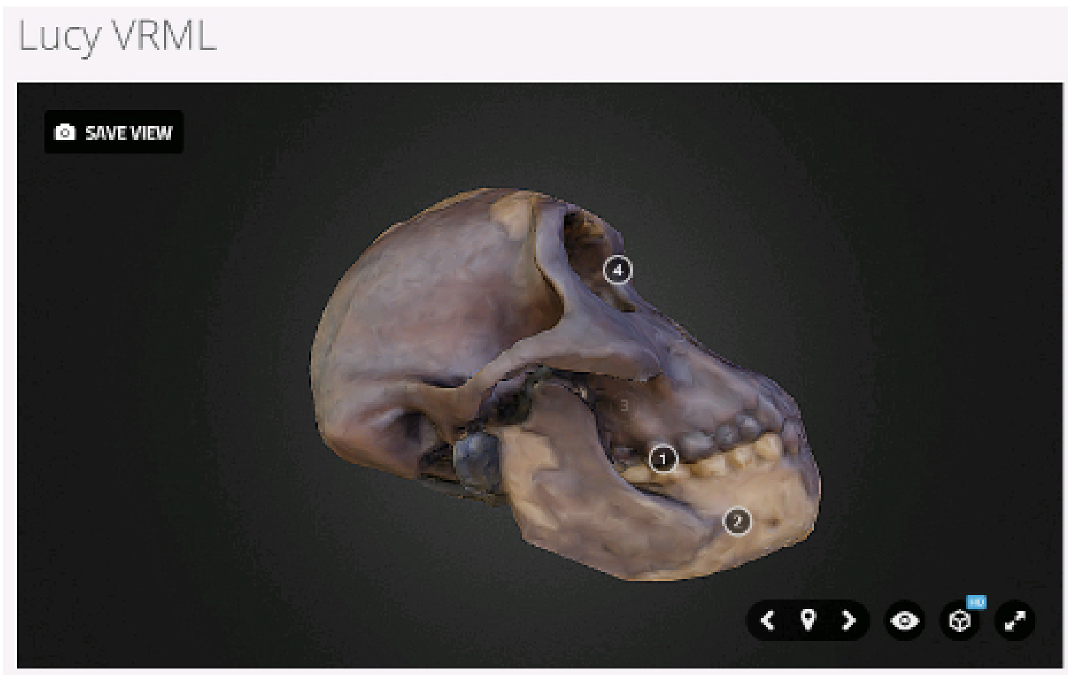

Figure 6. 3D, annotated Australopithecus afarensis cranium model stitched together from 80 photographs, presented online in Sketchfab. Source: Author.

mapped out in figure 2 have grown over time as I look for interesting ways in which I can present my work to students. The natural extension for me was a practice of handing the technology over to student to define problems, identify ways to approach those problems, and to let them collect field data on our campus, locally, or regionally on their own. Whether

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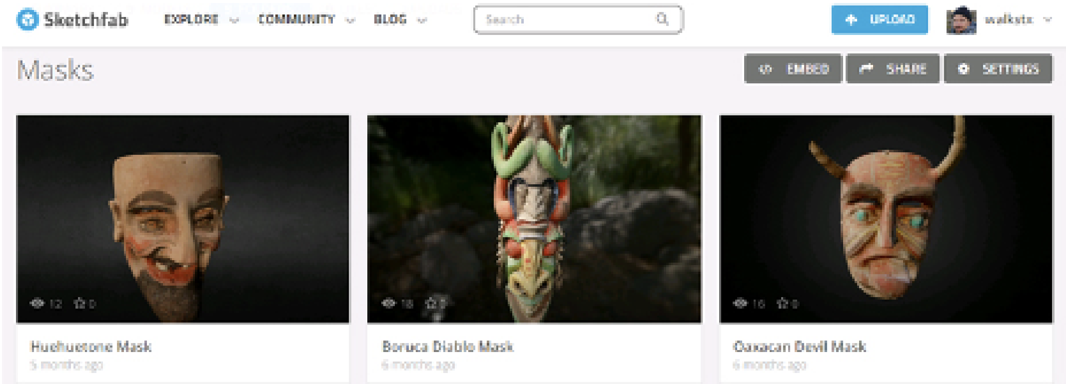

Figure 7. Collection of 3D models of modern Mesoamerican cultural heritage objects. Presented online in Sketchfab. Source: Author.

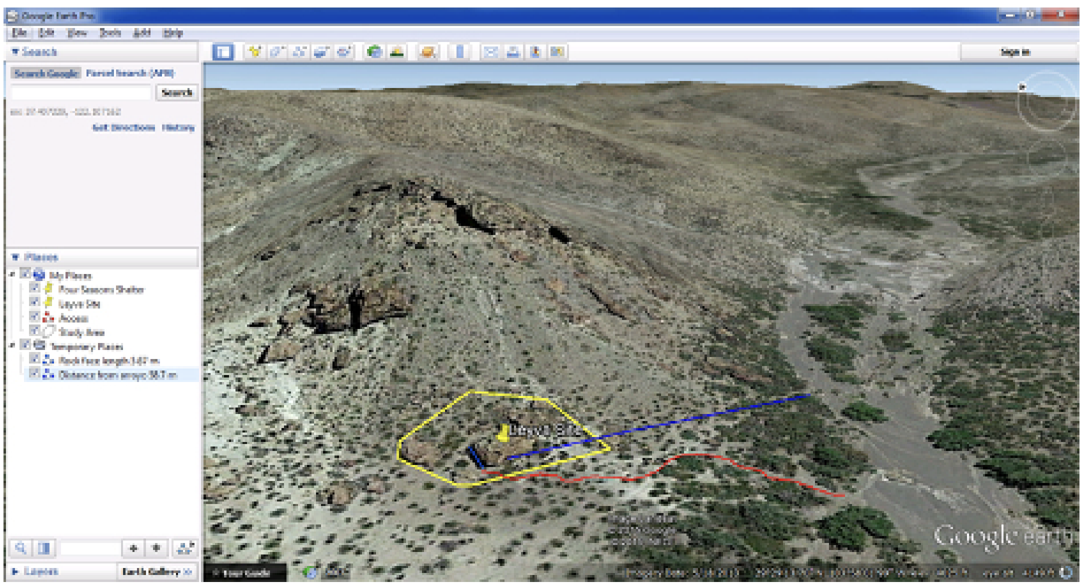

Figure 8. Trans-Pecos rock art site with measurements, GPS track, and study area in Google Earth. Source: Author.

your aim is to provide students with a workforce-oriented technology application background or to engage them in field-based projects and problem solving, low-stake technologies are plentiful, becoming ever faster and smaller, and when combined are very useful in the teaching of cultural heritage and ethnographic landscape studies.

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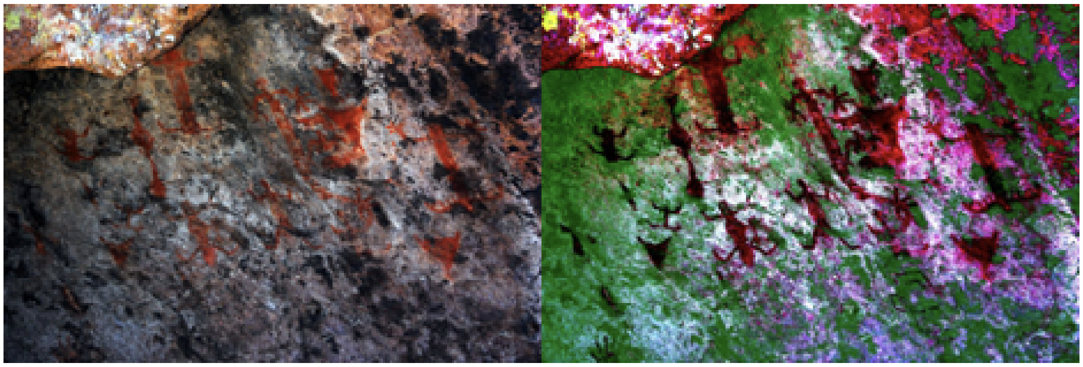

Figure 9. A decorelation stretch color enhancement (right) from an un-enhanced photograph (left) using ImageJ. Original image from a standard, consumer digital camera. Source: Chloe Walker.

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CHDK

N.d. Canon Hack Development Kit website. http://chdk.wikia.com/wiki/CHDK

Cultural Heritage Imaging

N.d.a Reflectance Transformation Imaging. http://culturalheritageimaging.org/Technologies/RTI/

N.d.b Photogrammetry. http://culturalheritageimaging.org/Technologies/Photogrammetry/

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