Digitally Modeling, Visualizing and Preserving Archaeological Sites

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Figure 1: (a) Integrated site model of the Acropolis at Monte Polizzo. (b) augmented reality reconstruction.

Preserving cultural heritage and historic sites is an important problem. These sites are subject to erosion and vandalism, and, as long-lived artifacts, they have gone through many phases of construction, damage and repair. We believe that it is important to use 3D model building technology to create an accurate record of these sites, so preservationists can track changes and foresee structural problems. From a digital libraries perspective, 3D models also allow a much wider audience to "virtually" see and tour these sites. This is a significant improvement over static imagery or video, in that immersive viewing is possible, and we can create new and novel views that could outline the historical and chronological transformation of a large site.

To test our methods, in July 2003 a team from Columbia University joined the Stanford University Monte Polizzo Excavation in Sicily, with the goal of digitally recording an archaeological excavation. We had three goals for this project: to capture the site's current state on a daily basis using several sensors; to create an integrated 3D site model that would include geometry from laser range scans, and photometry images and video; and to record changes as different layers were exposed.

3D Modeling: Due to the complexity of these sites, building 3D models is time-consuming and difficult, usually involving much manual effort. We have developed a suite of new methods that can reduce the time to build a model through automation. Our methods utilize range image segmentation and feature extraction algorithms. Once the 3D model is constructed, it is necessary to texture map it with imagery to create a geometrically and photometrically correct model, as shown in Fig. 1(a). Texture mapping can pose difficult problems in providing complete and accurate coverage of a complicated model. Our methods uses knowledge of shadows and sun position during the image acquisition process to correctly register the imagery with the constructed 3D model.

Archaeological Visualization: We are developing a 3D visualization environment to aid archaeologists in their post-excavation interpretation and analysis. In our prototype, a user wearing a head-tracked, see-through, head-worn display can explore a virtual dig site, as shown in in Fig. 1(b) (seen through a live videomixed display, representing a second user's view). She is able to view the surrounding terrain as either a textured point cloud or a textured mesh. Small archaeological finds are placed around the dig site at the locations of their discovery, each labeled with its name and description. A 360-degree panorama, recorded at the actual site, can optionally surround the model to provide an immersive virtual experience. As the user walks around, she can inquire about situated objects through a combination of speech and gesture, or navigate using a wireless mouse. Additional information about specific objects is available in the form of still images, videos, and textual descriptions that can be presented on the head-worn display.

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Categories and Subject Descriptors

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Documentation, Algorithms

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