Scalable Visualization of Super High Resolution 3D Images for Museum Archiving

A. Basu, I. Cheng, A. Mistri, and D. Wolford
TelePhotogenics Inc., Univ. of Alberta, Canada
and SGI, California
research@telephotogenics.com, www.Zoomage3D.com

Introduction and technology

In this report we describe and demonstrate our technology for creating and browsing super high resolution (SHR) & 3D digital content for a variety of applications including museum artifacts and galleries, archeology, anthropology, art design and heritage conservation. SHR 3D images and associated wireframes require large bandwidth to be transmitted in full detail. To address limitations resulting from limited bandwidth, two operations are performed: (i) bandwidth is optimally monitored using a statistical model and (ii) the quality of the 3D objects transmitted are adjusted to best fit the measured bandwidth. Regions of interest (ROIs) specified by users are stored in multiple levels of detail hierarchy. Our approach extends past systems [Martinez et al. 2000] for 2D image browsing, and supports quality of service (QoS) [Vogel et al. 1995] based retrieval. Experimental results demonstrate the feasibility of the proposed approach.

Figure 1 (left) shows a picture of the 3D scanner that can capture up to 200 Mega Pixels (approx. 5 K x 40 K x 24 bits) RGB texture & 2.5 Million or more polygons, automatically integrating 3 physically separated R, G, B channels. By comparison Minolta Vivid, Cyberware and Arius3D can capture only up to a few mega pixels and require multiple scans with different filters.

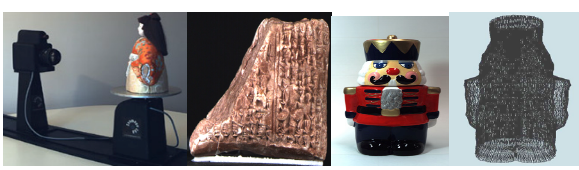

Figure 1: (from left to right) Zoomage3D scanning device, a tiny 3x2 sq.in. stone with writing on it, a 1 ft tall nut-cracker toy and a 18,720 polygon wireframe of the toy.

Efficient visualization

One of the problems associated with SHR 3D objects is the enormous amount of data used for object representation. This creates a major challenge for visualization and transmission. We have designed a Zoomage3D browser that can adjust the quality of a 3D object for online applications using multiple levels of detail on the wireframe of the 3D object. The texture of an object can also be stored at different levels of resolution. Depending on the available bandwidth, a simple adaptive strategy would select the resolution level and/or the number of vertices in the wireframe model to best fit the available resources. The drawback with this approach lies in the fact that the quality of the entire object is adjusted based on the available bandwidth.

A better approach would allow a user the ability to adjust quality on selected regions of interest (ROI). The approach is different from a purely hierarchical representation [Laur and Hanrahan 1991], as described in Figure 2. The ROI based approach can be modified to a foveation [Basu and Wiebe 1998] based algorithm to make resolution change continuously from points of interest (foveae) to the periphery and allow multiple foveae to be easily integrated into one view. The technology is currently being applied to archive content at the University of Alberta (UofA), Museums & Collections (Figure 3). Beta tests are being conducted with writings on stone in Minnesota (Figure 1).

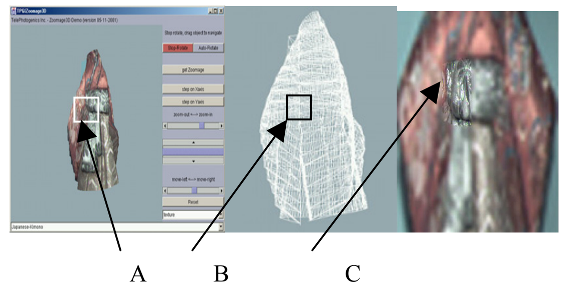

Figure 2: A region of interest selected on a browser (A) can be used to identify the corresponding bounding box on a wireframe (B) and associated texture to generate a high resolution region (C) that can be integrated into a lower resolution background.

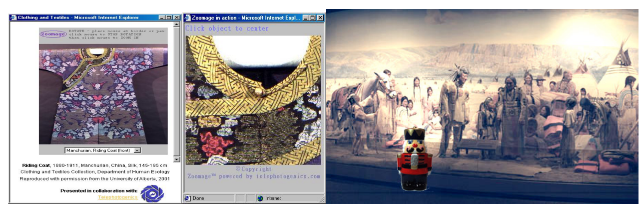

Figure 3: (left) A Manchurian riding coat from the UofA museums; (middle) interactive online zoomed in view of neck of robe; (right) a SHR panoramic image of a gallery from the provincial museum of Alberta with a 3D object (nut-cracker toy) added in.

Future work: Integrating 2D and 3D imaging for Museum Content

For archiving museum content it is desirable to capture panoramic scenery with a SHR camera and allow some objects in it to be visualized in 3D. Figure 3 (right) shows a gallery at the provincial museum of Alberta, with some 3D objects, such as the nut-cracker placed on the high resolution 2D scene. Viewers can both zoom into details of the 2D scene as well as view certain objects in 3D within the scene. Data acquisition for a SHR 2D-3D composite scene creation would require capture by a high resolution panoramic camera (Zoomage360) followed by 3D scan of certain objects within the scene.

A collection of demonstrations relating to the Siggraph presentation can be seen at www.zoomage3d.com/Siggraph.htm.

References

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Vogel, A. et al. 1995 Distributed Multimedia and QoS, *IEEE Multimedia*, Summer 1995.

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