

Zoomage™ : Super High Resolution Imaging & Visualization Tools

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ABSTRACT

In this paper we describe and demonstrate our technology for creating super high resolution (SHR) & 3D digital content in a variety of applications including museum artifacts and galleries, archeology, anthropology, art design and heritage conservation. Our hardware can capture minute details of static scenes in a composite panoramic format with details surpassing the human eye. We also propose an approach to storing SHR images for efficient retrieval over bandwidth limited networks, such as the Internet. Regions of interest (ROIs) specified by users are stored in multiple levels of detail hierarchy. This hierarchy can be created by analyzing the contrast, texture or other feature changes with varying levels of resolution and creating a hierarchy of ROIs. The depth of the hierarchy for a given ROI is determined by following the changes in the contrast (or other feature) gradient over adjacent levels. An implementation of the browser for Virtual Museums is also presented. In addition to browsing images, our software provides the ability to support "interactive story telling." As viewers interact with a picture using a mouse, the descriptions of objects in the scene appear depending on the location of the mouse and the level of detail in the scene. Finally, the "Zoomage" tools can be used by academic researchers for

various applications including object recognition, digital archiving, accurate stereo reconstruction, and 3D visualization.

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ZOOMAGE360 AND ITS APPLICATIONS

TelePhotogenics Inc. (TPGI)'s super high resolution scanning camera, Zoomage360, is specially designed to capture SHR, Super High Quality content for heritage and archeological sites, museums artifacts, dioramas, and priceless art. Figure 1 shows a picture of the SHR capture device, which uses state-of-the-art laser technology. The main advantage of this technology is sheer resolution of the image it can acquire. Zoomage360 can acquire an image up to 5300 x 40,000 pixels for a complete 360-degree panoramic scene. Each pixel location in the captured image has distinct R, G, B values, using accurate calibration of the three-color scanning channels. The technology creates SHR content in a matter of

minutes, without any stitching and manipulation of images, for a price only slightly higher than low-resolution software based technologies for panoramic imaging. We have created an easy to use User Interface with a standard USB connection. The user interface also includes computer-controlled gain and shutter adjustments that allow users to take into account the lighting and brightness conditions for a scene. SHR captured content can be used in IMAX theaters (IMAX uses 4000 x 4000 resolution), Silicon Graphics Inc. immersive Reality Centers (RC's) down to a web based application. In short, a complete solution is provided for content acquisition and viewing of SHR content. The 3D scanning option, Zoomage3D, uses a patented technology using a structured laser that is placed on top of the imaging device (Figure 1, top part). The device uses computations based on geometric projections of carefully designed laser patterns, unlike stereo matching based techniques [7-8].

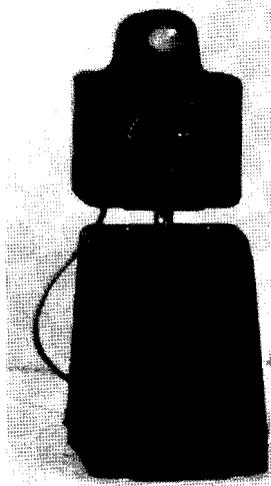


Fig. 1: Zoomage360.

3D SCANNING

In order to scan objects in 3D two scanning modes can be used:

- ◆ Static object and rotating camera; and
- ◆ Static camera and rotating object.

For the first mode the configuration is as shown in Figure 1. In this mode only one side of an object can be scanned at a time and several segments need to be stitched together for a complete view of all sides of an object. The scanning is performed in two stages: in one stage the object is scanned only for texture content, as shown in Figure 2; in the second stage the same object is scanned with a laser pattern projected on it (Figure 3). The laser pattern can be processed by software that detects a fixed number of laser points for each vertical line (Figure 4).



Fig. 2: Texture scan of a doll.



Fig. 3: Image with laser pattern.

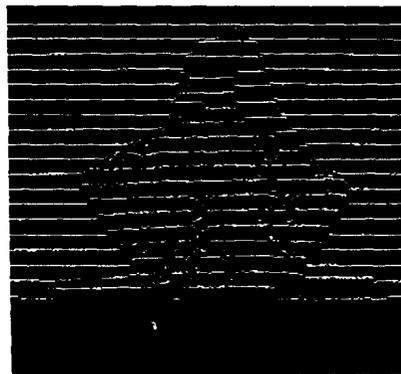


Fig. 4: Detected and segmented laser patterns corresponding to previous image.

It can be observed that the texture image and laser pattern image are captured from identical viewpoints, and the same image sensors are used to record both the texture and the laser data. Thus registration of texture with locations at which depth is estimated is automatic and does not require any special processing.

The background lighting in Figures 3 and 4 is the same indoor illumination. However, during the laser scan it is

preferable to turn off the background lighting to make the laser patterns more prominent and easy to detect.

Screenshots of the JAVA3d interface showing different parts of the rotating costume of the doll are shown in Figure 7. Since only a front view of the doll was acquired in the rotating scanner mode, the model was duplicated for a 360 degree rotation mode.

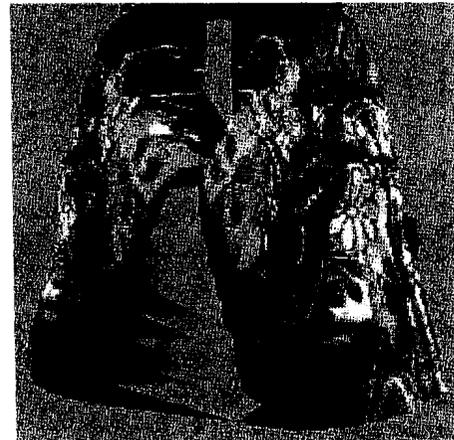
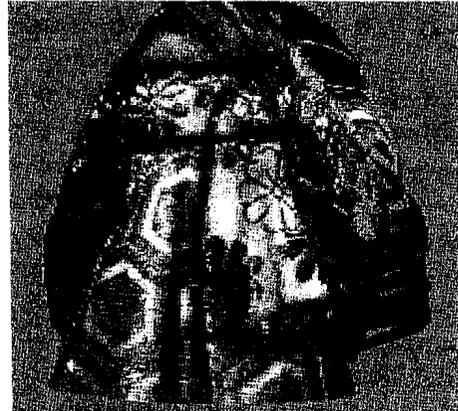


Fig. 7: Screenshots from JAVA3d display of doll.

VIEWING OF SHR IMAGES LEVERAGING COMPUTER HARDWARE AND LARGE-SCALE VIEWING FACILITIES

We have also co-developed another approach for interactive viewing of SHR images - using dedicated hardware, software and viewing facilities. Viewing a 5,000 x 40,000 image on a PC might not be the best way to view SHR content, so we teamed with Silicon Graphics Inc. to put some of their innovations for viewing. Most research institutions and universities own high performance graphics computers made by SGI. Museums, Science Centers and other markets around the world are using SGI Reality Centers as immersive theaters for viewing content.



SGI™ Reality Center™:

SGI Reality Center Group visualization solutions provide collaborative immersive viewing and interaction in real time. Reality Center facilities immerse you in your data so you can perceive it much as you perceive the physical world or in a way that is impossible in the real world.

The Reality Center solutions provide the highest resolution graphics, allowing you to interact with life-size imagery on a large screen and achieve never-before-imagined results via true

interaction with large data sets.

Merging the capabilities of TPGI's SHR technology and SGI's powerful visualization solution, we can truly see the future of powerful digital asset acquisition and SHR viewing.

THE ZOOMAGE™ BROWSER

TelePhotogenics Inc.(TPGI)'s Interactive Zoomage™ browser is specially designed to manipulate the display of super high resolution images captured by the TelePhotogenics digital camera, Zoomage360. A custom Zoomage™ browser can be implemented to meet the requirements of different applications. As shown below, the example of a diorama is set up for the Provincial Museum of Alberta. The Zoomage™ browser can be used to obtain a preview of a show on the Internet, or high quality theaters using the SGI Onyx3000 graphics computers in 160 degree (3084 x 1024 resolution) SGI Reality Centers. The focus of our work is not on creating multi-resolution image viewing software [1], but more on software that allows user interactivity and background hardware that allows high resolution content creation. Our software is designed to be compatible with the JPEG, JPEG2000, and the Region of Interest (ROI) processing in MPEG-7 [2-4]. The goal of our software is not only to have efficient data representation, but also to add an element of user interactivity that is often missing from other browsers [5-6].

Problems encountered when displaying Images on the Internet and Information Kiosks:

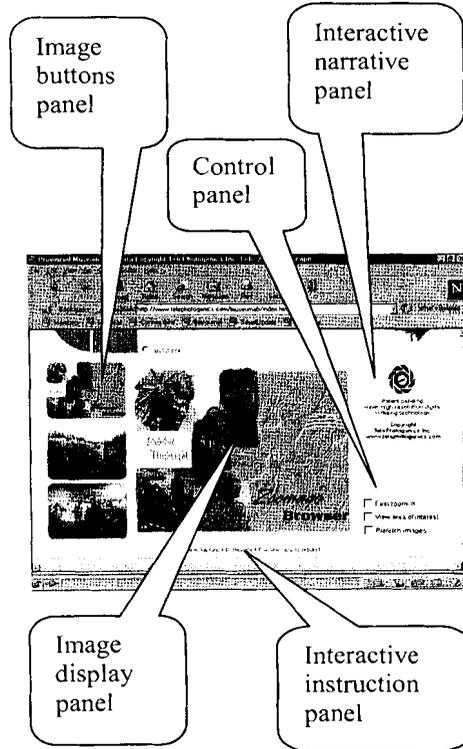
- ◆ Images are of low resolution and thus cannot represent the real quality of objects or products for E-Commerce.
- ◆ High-resolution images take too long to transmit.
- ◆ Images are scattered across pages or displayed on different screens, which makes it difficult for users to relate various objects to one another. Following one link after another, viewers can easily get lost.

Zoomage™ Approach:

- ◆ Provide super high-resolution images, which truly represent the quality of the underlying objects.
- ◆ Utilize the Zoomage™ browser, which efficiently transmits high-resolution images.
- ◆ Support interactive browsing allowing the viewer to choose different images and descriptions without jumping between screens and pages.

How to use Zoomage™ Interactive browser ?

Operating instructions are also available on the web, and interactively provided on the browser screen.



“Interactivity” is an important feature of the Zoomage™ browser. The mouse position on the Image display panel will trigger off the display of the associated description on the Narrative panel. At the same time, the viewer is guided by the hints on the Instruction panel. A zoom-in or zoom-out display can be obtained by a mouse click.

The initial “**Highlight**” screen is another outstanding feature of the Zoomage™ browser. It is a collection of appealing objects selected from individual pictures.

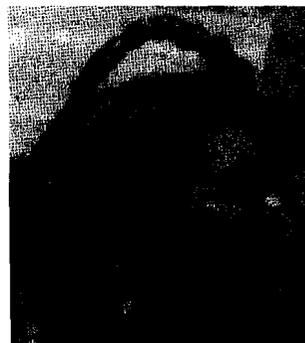
◆ **Image buttons panel**

When the mouse moves over a button, the description on the Narrative panel will change. A different topic will be displayed on the Image panel by clicking an image button.

◆ **Image display panel**



An area of interest can be an object or a scene. It is indicated by a blue oval, which can be turned on and off by checking the “**View area of interest**” box. By clicking inside the area of interest, a zoom-in image will be displayed.



FUTURE WORK

We are currently extending the Zoomage software to handle 3D imaging. As well, applications in other areas including medical, forensics, and computer graphics are being investigated.

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