Visualisation of novel high resolution digital photography

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ABSTRACT

There exist a number of technologies for capturing high resolution digital photography and subsequently presenting it on novel display devices. There are often challenges due to the volume of data involved and the desire for a versatile remapping in real time on innovative display geometries. The issues associated with real time display and visualisation of high resolution imagery are likely to be encountered with image capture in other disciplines as sensors continue to improve. In this presentation the characteristics of some of the photographic capture options and subsequent display devices will be discussed. Examples will be presented in the areas of virtual heritage visualisation, remote operations, survey and capture of geographic data.

INTRODUCTION

Two novel image capture modalities will be discussed, gigapixel photography and panoramas. In each case the resulting imagery can be viewed/explored on standard resolution flat displays by appropriate geometry corrections. There are also visualisation and presentation hardware that provide a more natural match to the underlying image geometry. Irrespective of the exact image type and display mechanism, one needs to deal with image warping and processing of high resolution images in real time.

GIGAPIXEL PHOTOGRAPHY

Gigapixel photographs, as the name suggests, are single images with a resolution close to, or exceeding, one gigapixel (10^9 pixels). Such images can now be acquired in the field with quite modest hardware: namely a reasonable SLR camera and a motorised mount[1]. As such they are increasingly being used for site recordings in archaeology and heritage applications. Multiple photographs are taken of the scene with a narrow field of view camera lens and these photographs are then usually acquired in a regular grid, figure 1. These discrete images are stitched together to form a final seamless image.

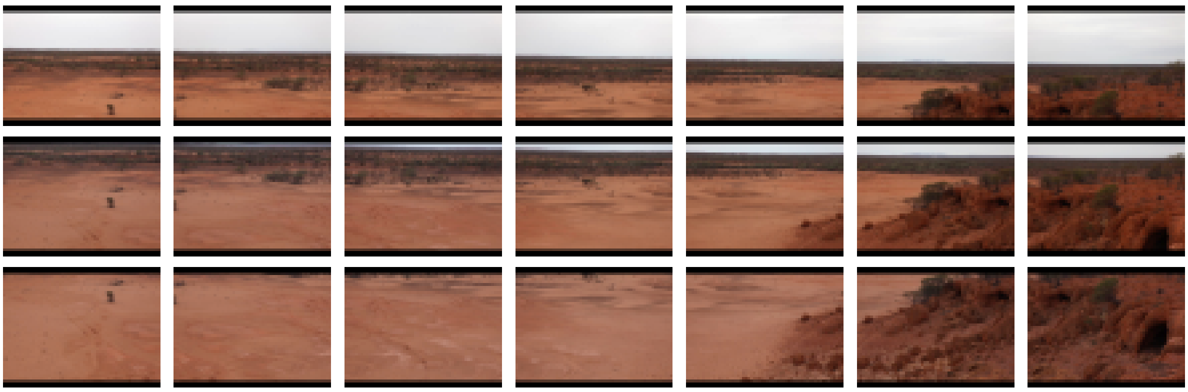

Figure 1. Image pieces that will form a gigapixel image of the ASKAP site in Boolardy.

A gigapixel image can obviously be viewed on a standard computer display. Note that even the higher resolution displays on the market are typically 2560x1600 pixels, a mere 4 MPixel, and the highest resolution projectors are only 8 MPixels. As a result one explores such images by repeatedly zooming in to see the detail and zooming out to see the context. A process similar to the way users interact with GoogleEarth. To overcome this limitation in display technology and to assist with the visualisation of such imagery one can tile displays or projectors together. Tiling high resolution displays together is the most cost effective means of creating high pixel counts, the display at UWA has a 4x2 tile of high resolution panels for a total resolution of 33 MPixels. The problem with such an approach is the gap between the panels, although this can be ameliorated by compensating for it in the image display software. A major advantage over tiled projector solutions is the comparatively modest space required. Projector based display walls can be made seamless by overlapping and edgeblending the images, this is at the expense of a more complicated software and calibration exercise.

PANORAMA

Panoramic photography in the form of cylindrical panoramas has long been a popular means of capturing site information for applications in virtual heritage and surveying. More recently the capture of stereoscopic panorama[2] pairs has been developed along with the presentation of such images within a 360 degree stereoscopic cylindrical display[3]. Such a display is an exact match to the captured image geometry and results in an extremely immersive user experience.

Figure 2. Left eye of a stereoscopic panorama pair, Mosque in Turkey.

An extension to cylindrical panoramas are full spherical panoramas. These capture the entire visual field about the camera, 360 degrees in longitude and 180 degrees in latitude. Such images are the most complete method of recording a site in that they allow one to subsequently interactively explore the entire visual environment. This is the essence of QuickTime VR[4] and similar technologies.

This form of surround capture has now been extended to not only still images but movies. From a viewing perspective one can now freely navigate within a movie. One such capture device is called the LadyBug-3 camera[5], it captures 360 degrees in longitude and about 140 degrees in latitude as video. Image resolution for the spherical panorama is 5400x2700 pixels. As with QTVR these can be viewed in real time on a flat screen by deriving the correct perspective projection but they are a better fit to being experienced within a hemispherical dome such as a planetarium or personal iDome[6]. In a similar fashion to the viewing of cylindrical panoramas on a cylindrical display, viewing spherical panoramas within a hemisphere results in a very natural and immersive data exploration experience.

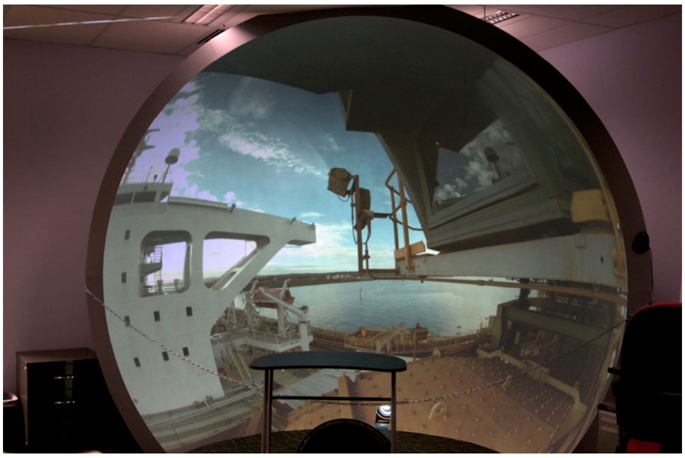

Figure 3. Spherical video within a hemispherical display.

The data rates from such a spherical video recording are daunting, about ½ GByte/sec uncompressed, or 2 TBytes for 1 hour of recording.

CHALLENGE

The hardware to capture high quality imagery and subsequently present that imagery in standard or more novel environments has been developed and is continuing to evolve. The challenge now is twofold: to unify the tools required to present/edit each type of projection appropriately and to interactively manage the large volume of data associated with high resolution images and video. The projections commonly encountered are plain perspective, cylindrical panorama, spherical panorama, and fisheye. Each of these has a different geometry correction that needs to be applied depending on whether it is viewed on a flat surface, or within a cylinder, or a hemisphere. As sensors in general continue to increase in resolution the techniques and algorithms required to store, retrieve, manipulate, and visualise the data in real time will continue to be challenging.

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