Beacon Island Report / Notes

Paul Bourke, iVEC@UWA, 17 February 2014

During my 2013 and 2014 visits to Beacon Island four general digital asset categories were acquired, they were: high resolution panoramic images (also known as gigapixel images); 360 x 180 degree bubbles (also known as equirectangular spherical projections); photographs intended for use as building textures as well as general textures (coral, sand, flora, etc); photographs for 3D model reconstruction purposes. These assets, while serving also as a general record of the site were mainly intended to enable the creation of a virtual environment, that is, ways of experiencing/exploring the island digitally.

High resolution photographs

The resolution of a single SLR camera sensor is limited, that is, one cannot buy an arbitrary high resolution sensor. The solution to generating very high resolution images is to take a number of overlapping images and using image processing techniques find matching points and eventually align, stitch and blend the images together. This is a relatively widely used technique employed in a wide range of applications from microscopy to the Hubble Space Telescope. The resolution of the final image depends on the number of photographs taken, the field of view of the lens, and the camera sensor size. The resulting images can form a valuable digital record since it captures both the detail, and if one zooms out, the context of the site. The principles and techniques employed are not that different to those used in Google Earth.

A number of high resolution wide angle panoramic images were acquired, in particular, from the end of each jetty and from locations on the beach near the main jetty. The image in figure 1 gives an example of the angular range of the images captured and the detail. Generally such images are taken using a motorised or robotic unit in order to automate what might be a large number of images taken across a regular grid. In the case here the images were taken manually although using a precise angle graduated scale on the tripod.

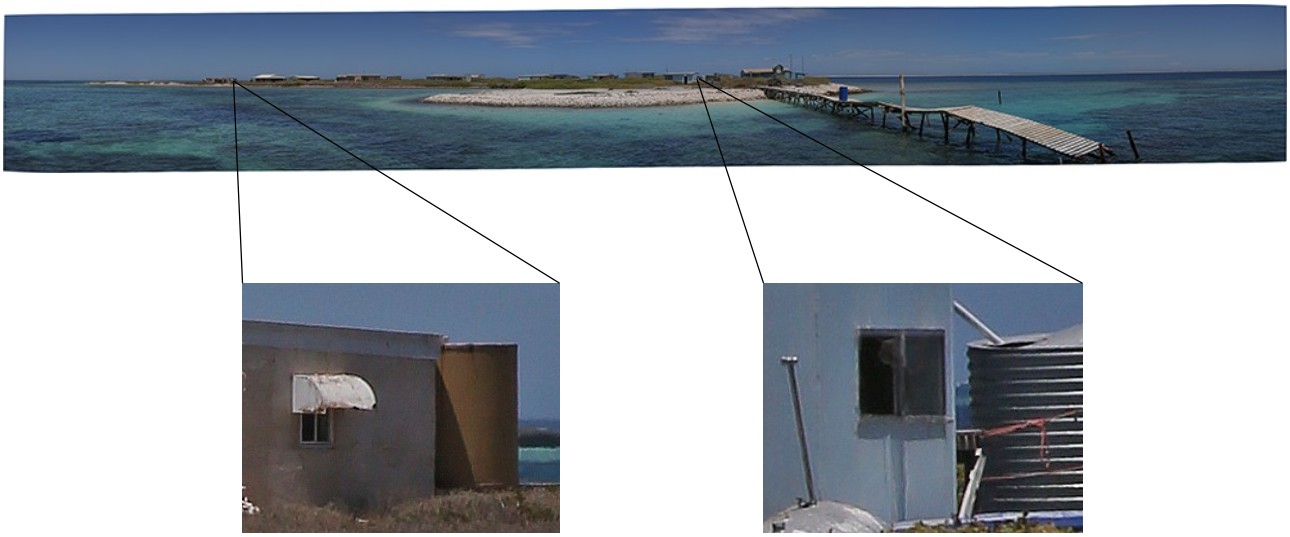

Figure 1. High resolution image from the main jetty, 45,000 x 7,000 pixels. (2014)

Figure 2. High resolution images from the other two jetties on the opposite side of the island. (2013)

Bubbles

"Bubbles" is the term given to 360 degree by 180 degree panorama images captured from a single position. These can be captured like the high resolution images above, but the term as used here refers to moderate resolution images (around 8,000 pixels across). The distinction is that these can be captured very quickly, within minutes, using a SLR camera and 180 degree fisheye lens (Canon 5D Mark III and 8-15mm fisheye zoom lens). In 2013 bubbles were captured from regular points across the island on the outside of the buildings. Additionally bubbles were from a position, sometimes two or more, within every room on the island. The positions chosen were generally central positions except where that might be obstructed or in some cases a mirror would reveal the camera and photographer. The 2014 survey completed this for the three building for which access was not previously available. The 2013 survey also saw points captured on Long and Seal Island.

While the above images look distorted that is just a result of the mapping of a sphere onto the plane, similar to the distortions that arise from Earth maps where the north and south poles appear distorted. When viewed in the correct way there is no distortion. Such images are a common way of populating a so called "virtual tour" where one jumps from position to position and at each discrete position is able to freely look around and zoom.

In total there are now 40 external bubbles and over 100 bubbles from the rooms in the buildings.

Figure 3. Center of room 2 on building 3. Every room in every building was photographed in this way.

Figure 4. Example of an external bubble.

Figure 5. Bubbles from the main jetty after the mid section was damaged between the 2013 and 2014 trips. (2014)

Textures

In order to create a believable 3D virtual environment of the island it is necessary to capture images that can be used as textures. The geometric detail of a virtual space may be limited but apparent detail can be presented through careful placement of textures. The textures captured are applied to the building structures derived from the measured floor plans. In addition textures can be captured that will allow believable models of the island landscape and as a means of creating models of the flora. The building facades captured by the maritime museum can be used for the building textures but there are benefits in having additional high quality, orthographically captured images of individual features such as windows and doors. An attempt was made to photograph every door and window of every buildings, noting that in some cases this was not possible due to access constraints.

Figure 6. Example of orthographic capture of building features.

Figure 7. Photography of plant material in order to create believable virtual plants.

Figure 8. Images of coral and sands in order to create landscape textures.

3D reconstruction

The automatic reconstruction of digital models entirely from photographs is an exciting new capability that is being actively explored and researched by the author. While not new, the quality of the algorithms has increased rapidly over the last few years. As a result and with knowledge of how to capture the images optimally means that the resulting models are becoming increasingly detailed and accurate. This is emerging as a powerful method of recording 3D structures that might otherwise be hard or time consuming to model manually.

The two structures on the island that were targeted for this reconstruction were the coral "building" and the cairn. Both would be very difficult to create manually and if they were manually created would be only representative of the structure rather than accurate. As an indication of the progress in the software in this area and the new experience in how to optimally take photographs and a new calibrated prime lens, the results in figure 9 from the 2014 trip were significantly better than a similar attempt in 2013.

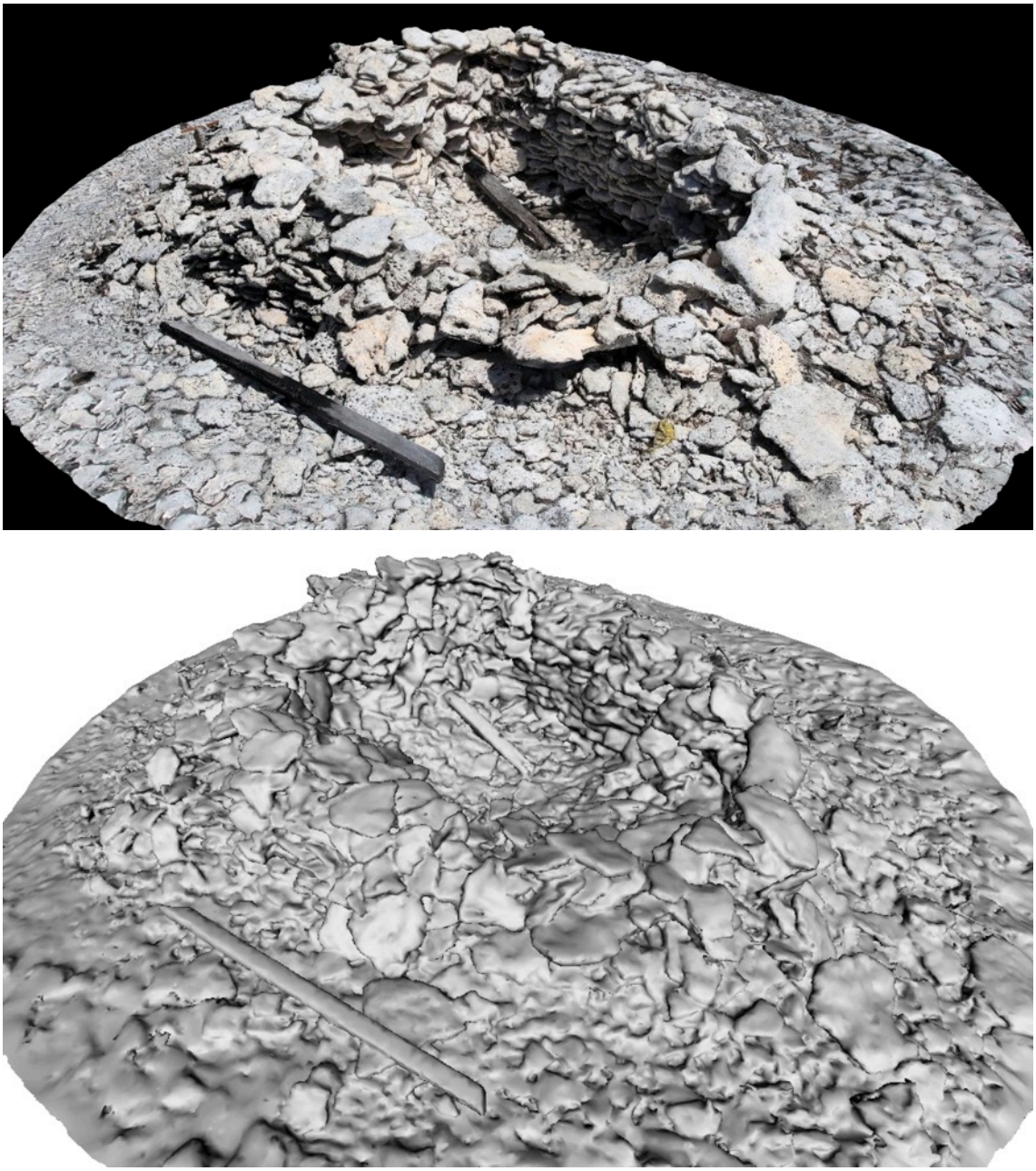

Figure 9. Computer rendering of the textured mesh (top), the underlying geometry (below).

Figure 10. Reconstruction examples of the cairn, mesh on the left, textured mesh on the right.