TEXTURE MAPPING FOR 3D CRANIOFACIAL SURFACE MODEL: PRELIMINARY RESULTS

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Abstract

This research focuses on texture mapping (a powerful technique for adding realism to a computer-generated scene) for craniofacial applications. In its basic form, texture mapping lays an image onto an object in a scene. The texture mapping is important for 3D craniofacial data to help identify landmark in measurement process. Two close range measurement methods are used for data capture, i.e. laser scanning and digital photogrammetry. The process of texture mapping consists of 2 steps. Firstly, a human face is scanned from two laser scanners. At the same time, an image of the human face (from the front side) is taken using normal digital camera to capture the 2D texture. Secondly, the 2D image is draped onto the 3D laser scan data (using RapidForm software) to generate a 3D texture image. Some preliminary results are shown to illustrate this approach. For complete texture mapping, we plan to use multiple digital cameras (for different sides of the face) operating simultaneously, for generating a complete 3D image of a face. The 3D image will be draped onto the 3D laser scanned image.

1.0 INTRODUCTION

Texture mapping is a powerful technique for adding realism to a computer-generated scene for craniofacial applications. In its basic form, texture mapping lays an image (the texture) onto an object in a scene (Alvin et al, 2002). This is based on a stored bitmap consisting of texture pixel. It consists of wrapping a texture image onto an object to create a realistic representation of the object in 3D space. Texture mapping also was one of the first developments towards making images of three-dimensional objects more interesting and apparently more complex. It can be divided into two-dimensional (2D) and three-dimensional (3D) techniques of mapping. This research focuses on draping image from 2D photogrammetric stereo image onto 3D model of craniofacial surface. 2D image mapping allows bitmap images to be applied to a surface under the control of (u, v) texture coordinates that are associated with the polygon verticals, whereas 3D procedural texture mapping create a virtual texture on-the-fly by using a small procedural program applied at each pixel.

2.0 TEXTURE MAPPING FOR 3D CRANIOFACIAL DATA

In recent years, modelling and measurement of the human face is becoming more important for both medical and computer animation purposes (D'Apuzzo, 1998). In the quest for more realistic imagery, one of the most frequent criticisms of early-synthesized raster images was the extreme smoothness of surfaces (i.e. they showed no texture, bumps, scratches, dirt or fingerprints) (Heckbert, 1986). Usually, after scanning is performed, certain areas in the 3D craniofacial model are not clear and become dark, because the dark areas on the surface cannot be detected by laser scanner and the scanned data was triangulated. Consequently, the laser scanned images have holes in certain parts on the surface. In this research, draping image over computerized 3D model on the craniofacial surface was performed to make accurate measurement of anthropometric points.

3.0 METHOD

Two close range measurement methods are used for data capture, i.e. laser scanning and digital photogrammetry. 3D Laser Scanning is a laser range scanning devices based on light interferometry that provides a much more automatic tool for obtaining a digital model of an existing 3D object (Alvin et al, 2002). The scanner is also useful for capturing the 3D shape of physical objects, especially those with complex geometries and free-form surfaces. This technology can also used for generating a 3D model of a human face with registered texture.

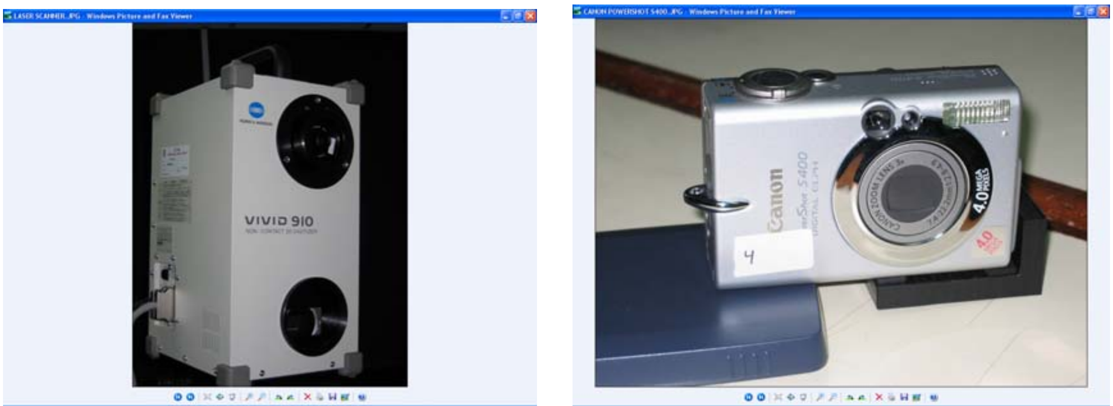

Figure 1: VIVID 910 and Canon PowerShot S400

In this research, the patients sit on a chair with facial muscles relaxed whereas eyes opened and lips closed for 7 second during the scanning. Two laser scanners (Figure 1) are used to capture scanned data using Polygon Editing Tool (PET) software. The scanning was performed using VIVID 910 (3D scanner operating on a laser-light stripe triangulation range-finder principle) and the distance of patient from the laser scanner was about 0.7 meter. At the same time, an image of the human face (from the front side) is taken using normal digital camera (Figure 1) to capture the 2D texture.

The scanned data was imported to RapidForm (a professional 3D reverse engineering) software for data processing. The steps to process the scanned data are registering, merging, fill holes and smoothing (Figure 2). Registration allows operator to register multiple point clouds or polygonal shells using overlapping regions (Figure 3). Secondly, the shells that have been aligned by registration process are merged into one united shell. During the merging process (Figure 4), overlapped regions between shells are removed and neighbouring boundaries are stitched together with newly added polygons. The result and accuracy of shells are still maintained after merging.

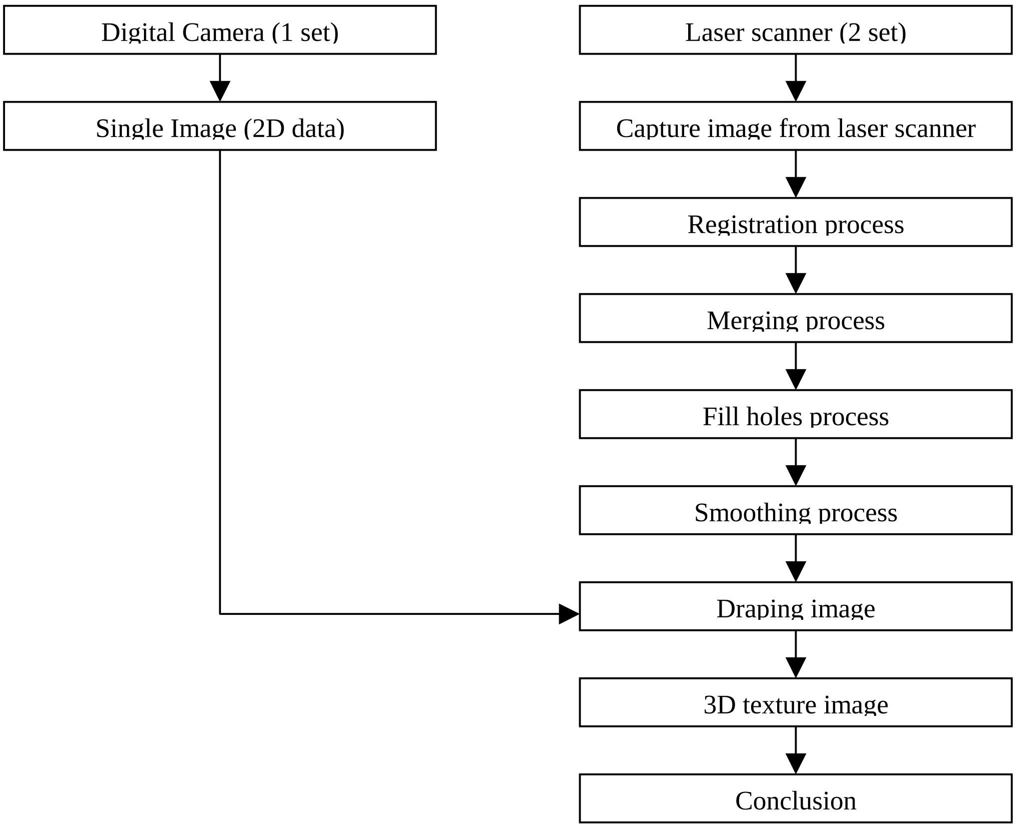

Figure 2: The flowchart to get 3D texture image

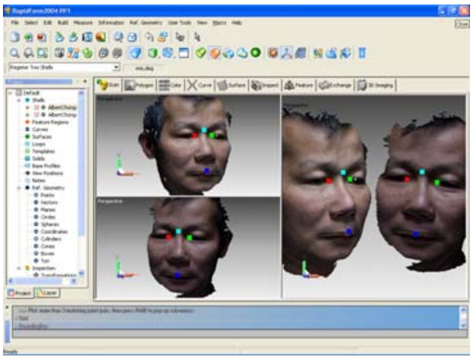

Figure 3: Registration process using image from laser scanner

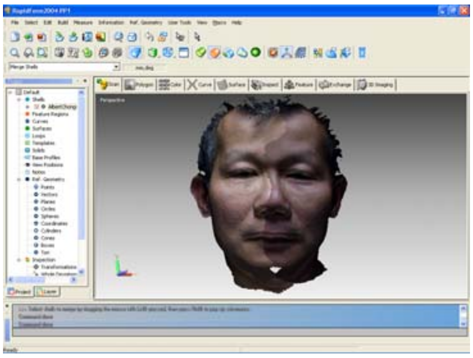

Figure 4: Merging process using RapidForm software

The fill holes operation (Figure 5) fill holes (Figure 4) in a model that may have been introduced during the scanning process. The operator constructs a polygonal structure to fill the hole, and both the hole and the surrounding region are remeshed so the polygonal layout is organized and continuous. Sometimes scanned data may have too much bump and detail of surface roughness in the scanning process. By smoothing (Figure 6) the polygon model, it can reduce this roughness.

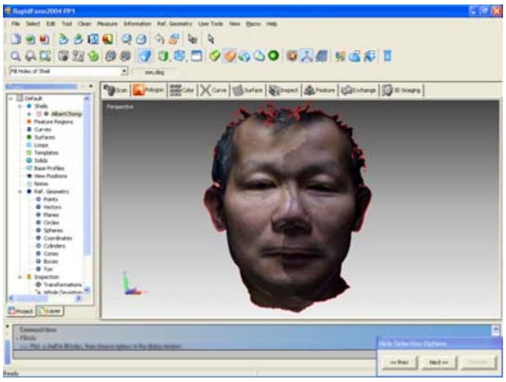

Figure 5: Fill holes process using RapidForm software

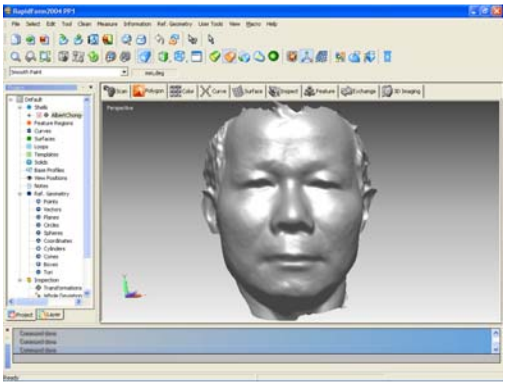

Figure 6: Smoothing process using RapidForm software

Finally, the 2D image from camera (Figure 7) was draped onto the 3D laser scan data (Figure 6) using RapidForm software to generate a 3D texture image (Figure 8).

Figure 7: Single image from digital camera (front side)

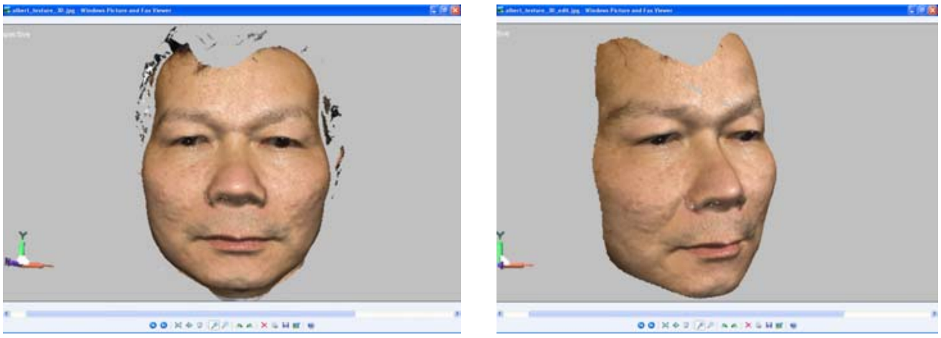

Figure 8: 2D image is draped onto the 3D laser scan data to generate a 3D texture image

4.0 CONCLUSION

This papers presents the preliminary results achieved to date. The 3D model was constructed by data processing (using RapidForm software) to produce one complete model. In this research, texture mapping is used to get the extreme smoothness of craniofacial surfaces. In the future, we plan to use multiple digital cameras (for different sides of the face) operating simultaneously to complete the texture mapping for generating a complete 3D image of a face. The 3D photogrammetric stereo image will be draped onto the 3D laser scanned image using RapidForm software.

5.0 ACKNOWLEDGEMENT

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