International Conference on Artificial Reality and Telexistence
Eurographics Symposium on Virtual Environments (2017)
T. Huang (Editor)



# Automatic Face Texture Generation from Irregular Texture in 3-D Character Creation Applications

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**Abstract**

*In this paper, we propose a novel face texture generation algorithm to enhance compatibility and reusability of 3-D face reconstruction results of real-world 3-D character creation applications. Our approach can handle irregular types of input textures of 3-D reconstructed face models using the proposed multi-projection texture generation technique. We automatically calculate exact pixel values of the frontal face region in the template texture map by finding correspondences between input and template 3-D models and textures, respectively. After matching tones of the frontal face region and the remaining parts, the final texture of a 3-D face model is successfully generated without manual editing or post-processing of textures.*

**CCS Concepts**

•***Computing methodologies*** → ***Texturing;*** *Mesh models; Virtual reality;*

## 1. Introduction

As the price of digital cameras or image sensors goes down, various kinds of mobile devices such as smartphones with multiple lens, depth sensors, etc., have been released competitively. Accordingly, they are being used to virtual reality(VR)/augmented reality(AR) applications as input data acquisition tools, processing units, or displays. As users want more immersive experience, demand for three-dimensional (3-D) contents for multimedia applications including VR/AR, games, 3-D printing, and so on, are rapidly growing.

One of the most prominent elements of 3-D contents is 3-D character. Unlike high-quality 3-D characters have been mainly used in movie or video game industry, there are increasing needs for lightweight 3-D characters in casual entertainment applications. Among components consisting the 3-D character, the face plays a key role to give an identity to the character and increase user experience. Users easily recognize resemblance or difference in a character's face and highly sensitive to it also.

There have been numerous researches and applications to reconstruct a 3-D character from capturing multiple pictures using a smartphone, depth sensors, and even from a single image of face [FNH*17] [IBP15] [JBAT17]. Trnio, Scann3D, ReCap 360, PhotoScan are real-world apps and software. However, most of them focus on static 3-D object reconstruction and rendering. It is limited to use the reconstruction results to other purposes like 3-D animation, 3-D printing, etc., because of messy geometry and irregular types of textures. Particularly, face textures produced by them are hard to be reused, so that manual labors are required to edit them [TMB*13] for fulfilling application specific purposes.

In this paper, we propose a novel face texture generation algorithm to enhance compatibility and reusability of 3-D face reconstruction results of real-world systems. Our ap-proach can handle any types of input face textures of the 3-D face models. We automatically calculate exact pixel values of the frontal face region in the template texture map by finding correspondences between input and template 3-D models and textures, respectively.

## 2. Proposed Automatic Face Texture Generation

There are two main approaches to utilize 3-D reconstructed face for other applications. One is to refine itself, the other is to deform template models to fit input. 3-D animatable models usually need lightweight geometry or rigs information. 3-D printable models require manifold polygons and thickness, but there are no such informations in input. Therefore, the former tries to directly refine the results to support those needs [IBP15] [SFW*14]. The latter starts by building a well-defined template model with texture suitable for target applications. After deformation, the deformed results can be directly used without further processing [LHYC15].

### 2.1. Problems of Versatile Texture Types

3-D face reconstruction apps produce irregular types of texture maps as shown in Figure 1. Multiple shots of an object are mapped to the 3-D geometry inde-pendently, so that there is no common texture type. If the tone of face region is different from the character's body, the scattered texture fragments should be processed manually for tone-matching [TMB*13].



DOI: 10.2312/egve.20171368

**Figure 1:** *Examples of irregular face textures: Autodesk 123D catch(left), Agisoft Photoscan(center), and Occipital Structure Sensor(right).*

### 2.2. Multiple Projection-based Face Texture Generation

We propose a novel algorithm to resolve those problems in texture processing for creating a 3-D human character based on the template-based approach. We calculate pixel colors of the template texture region corresponding to input. We only use the frontal face region of the input reconstructed face model to avoid noises or errors such as partially captured ears, hairs, etc. The pixel values of the frontal face region in the template texture are traced back through sequential projections based on the correspondences between input and template as depicted in Figure 2. The rest of the frontal face region is then processed to adjust colors and tones using the Poisson image blending technique [PGB03]. The template texture type and format are pre-defined in terms of application specific requirements, so that a common type can be applied easily.

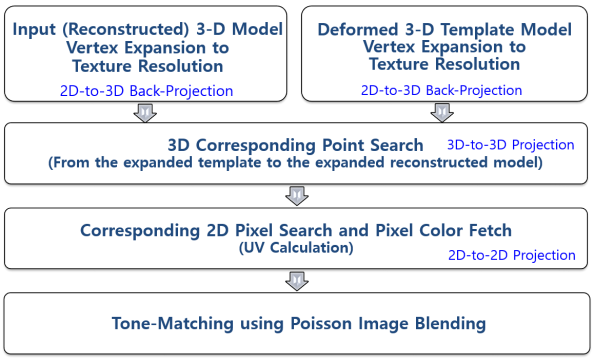


**Figure 2:** *Automatic face texture generation procedure.*

### 2.3. Experimental Results

We have presented the generated texture maps using the proposed approach in Figure 3 and Figure 4. The template model and texture in Figure 4 are designed for 3-D printing.

### 2.4. Conclusions

We have described a novel solution to handle irregular types of textures in 3-D reconstructed face models through deforming the template model texture. Our algorithm traces the exact pixel color of the frontal face region based on correspondences between input and template. The results show that post-processing can be easily applied to the automatically generated texture map.

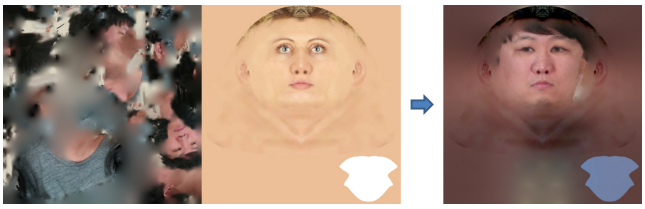

**Figure 3:** *Automatically generated face texture map (right) by the proposed multi-projection approach from the irregular input (left) and the template texture (center).*

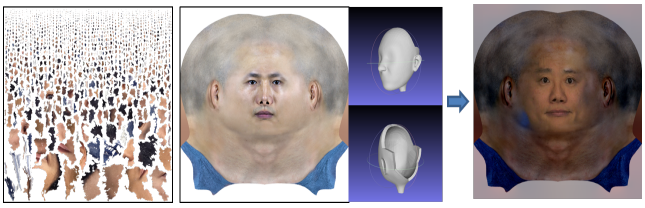

**Figure 4:** *Final texture map (right) generated by the proposed multi-projection approach from the irregular input (left) and the template texture (center) after tone-matching.*

### Acknowledgement

This work was supported by Institute for Information & communications Technology Promotion(IITP) grant funded by the Korea government(MSIT) (2015-0-00290 (R0126-16-1025), Development of 3D printing content creation/authoring/printing technology and its applications in the mobile environment).

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