Optimized binarization for eggshell carving art

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CCS CONCEPTS

• **Computing methodologies** → **Image processing**.

KEYWORDS

Eggshell carving, optimization, binary image, carving art

ACM Reference Format:
Thi-Ngoc-Hanh Le, Sheng-Yi Yao, Chih-Kuo Yeh, Sheng-Jie Wang, and Tong-Yee Lee. 2021. Optimized binarization for eggshell carving art. In *SA'21 Posters: Optimized binarization for eggshell carving art, December 14-17, 2021, Tokyo, Japan.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3476124.3488629

1 INTRODUCTION

It is amazing that something as fragile as an empty eggshell can be made into a beautiful piece of art. Egg carving is a delicate art form using precise tools to gently carve and cut away at the shell to form a three-dimension-surface model. This folk handicraft has gradually flourished in recent years. And in computer graphics, it is not only an interesting research field but also a potential industry product.

Given a color image and an eggshell 3D model, a new model can be generated in which surface mirrors the content from the given image after carving the holes. Finding the best fitted parts to carve is the key to generate a realistic carving 3D model. Yet, creating such master piece of carving 3D model from scratch is a tedious and time-consuming process that requires substantial expertise. To address this challenge, [Yang et al. 2019] preserve the image details by an optimal compromise between the black and white details. However, the images they get as input are the binary images. This prevents their method from challenging input images. In this paper, we introduce a framework to produce a carved model that is sculptured from an arbitrary color image. The designed objective function for optimization to generate the binary image from color image enables our system to produce visually pleasing eggshell carving results.

SA'21, December 14-17, 2021, Tokyo, Japan

ACM ISBN 978-1-4503-8687-6/21/12.
https://doi.org/10.1145/3476124.3488629

2 OUR APPROACH

This study aims at generating the binary image of an input color image to guarantee that the details on output carving model are sufficiently connected, visually artifact-free and structurally strong for an eggshell carving artwork. In the generated binary image, the black details indicate the parts that are to be carved while the white details indicate retained parts after carving. Fig.1 illustrates the major processes in our system. Our system gets as input an arbitrary color image and 3D eggshell model. We first adopt the proposed optimized binarization to generate a tailored binary image for carving. This resultant binary image is mapped on the given eggshell model. Thereafter, the textured model is carved to generate the carving art.

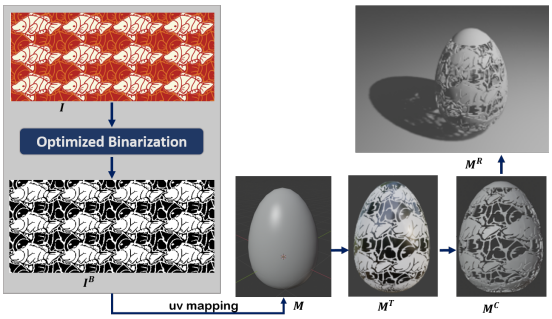

Figure 1: Our system overview

For the purpose of generating a tailored binary image, we design an objective function for optimization. To achieve this, we have two criteria. Firstly, important features in the input image should be preserved in the resultant binary image. Secondly, the remaining blocks after carving should be connected.

2.1 Optimized binarization

Given a color image, we segment the image into a several blocks. Each block consists of a set of pixels that have the same color and connected. We then construct a **Region Adjacency Graph** (RAG) from the segmented blocks. The RAG is used to generate the binary image through an optimization with three energy terms (1) *color difference*, (2) *area ratio*, and (3) *contrast*. Color difference is used to measure the differences between the color of the binary image and the input image. This terms is effective to preserve more tiny detail in the input image. Area ratio terms is to preserve the semantic structure of the input image on the 3D surface after carving. We control this issue by balancing the area of the black and white detail