

Sketch and Shade : An interactive assistant for sketching and shading

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ABSTRACT

We present a drawing assistant for sketching and for assisting users in shading a hand drawn sketch. The augmented reality based system uses a sketch made by a professional and uses it to help inexperienced users to do sketching and shading. The input image is converted to a set of points based on simple heuristics for providing a “connect the dots” interface for a user to aid sketching. With the help of a 2.5D mesh generated by our algorithm, the system assists the user by providing information about the colors that can be given in different parts of the sketch. The system was tested with users of different age groups and skill levels, indicating its usefulness.

CCS CONCEPTS

• **Computing methodologies** → **Rendering; Shape modeling;**

KEYWORDS

shading, paper sketch, Delaunay triangulation, inflation

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1 MOTIVATION

Sketching and coloring books are one of the most fun filled ways for children to express their creativity. Given a reference image/sketch, it is difficult for a novice user to draw it on a paper. To make sketching more interesting and easy for kids, sketching books use the “connect the dot” approach, where the user is provided with a numbered set of dots which, when connected in order, form the boundaries of the sketch. The



Figure 1: Plain coloring and Shading

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disadvantage of the approach is that the user needs to be provided with this set of numbered dots corresponding to the sketch.

Given an outer boundary, it is easy to fill the boundary with a single color. However, shading brings life to a sketch. A plain and simple sketch can be made attractive by shading it appropriately (Figure 1). A proper shading might motivate the user to get more involved in such activities as it gives a 3D feel to the 2D sketch. In applications such as shading, rather than computing absolute depth (which usual 3D reconstruction from a single image uses), it is perhaps sufficient to compute an approximate one (as in [Johnston 2002] and [Sýkora et al. 2014]). Shading also gives a symmetric 3D feel about the plane of the sketch. Hence, one can view the shading as creating a 2.5D feel rather than 3D, eliminating the need to go for computationally intensive procedures for computing 3D depth maps such as solving an optimization problem. Such an approach can also lead to reduced user intervention as the process of inflation can be made to an automatic one.

An augmented reality based interface is used in this system in which, the information relevant for sketching and shading is provided along with the camera feed to facilitate real time utilization of the hints provided by our system.

2 SKETCHING & SHADING

2.1 Sketching

Sketching procedure starts with a reference sketch given by the user. The structure lines of the sketch are extracted by doing a thresholding followed by finding a set of connected pixels. Skeletonization is applied to the extracted structure lines and fed to a simplified point set generator. Skeleton is decomposed into a set of points by sampling the shape (object to be sketched) based on a length parameter and by placing points on junctions and corners. To increase the ease of drawing process, user is given the flexibility to change the sampling density.

The sampled points are then projected onto a drawing paper, and are displayed one by one in an augmented reality environment (points are plotted on camera feed of the augmented reality based interface, which is an Android tablet in this case), enabling the user to connect them and complete the sketch. The points are displayed one by one to resolve ambiguous situation in which a point has to be connected to more than one neighbor, or the distance between points in different feature lines are almost same as two adjacent points in the same feature line. In the interface, the user is given options to change the point set density as well as the speed and size in which the points should appear. The points are displayed continuously until a previously drawn point or an endpoint is reached.

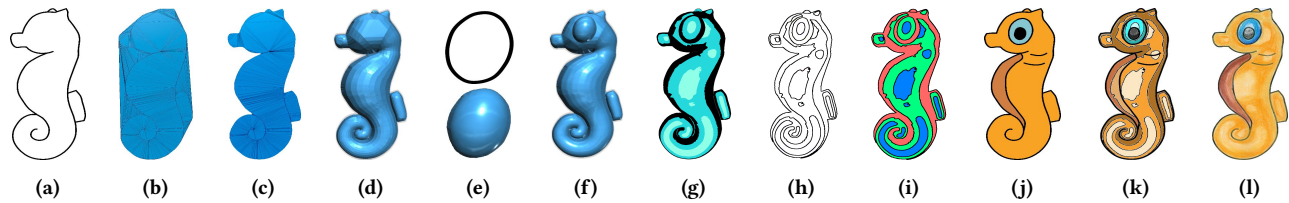


Figure 2: Complete shading procedure

The displaying process, then continues along undrawn branches. Based on the suggestions from users, the switching time from one curve to another one is kept relatively high. Some users found it easy to draw when they had an idea about where the next dot is going to come. To include this feature, the interface is given with an option in which user can see all dots in a different/transparent color.

2.2 Shading

The complete shading process is shown in Figure 2. Initially, the boundaries that need to be inflated are extracted from the input image. User input is needed to eliminate extraneous lines or textures that are not part of the boundary (Figure 2a). The boundary is converted to a set of points by denoting each pixel by a 2D point. Delaunay triangulation (Figure 2b) followed by sculpting (Figure 2c) is applied until all edges lying exterior to the boundary are removed. The remaining triangles are classified into junction, sleeve and terminal triangles as in [Igarashi et al. 1999]. Each triangle is replaced by an appropriate surface patch as shown in Figure 3 to create an inflated mesh (Figure 2d). The process is continued for each boundary (Figure 2e) and resulting patches are superimposed to complete the 2.5D model (Figure 2f). Mesh collapse compression followed by the midpoint subdivision algorithm are applied to the final inflated mesh to make it smooth. Toon shading (Figure 2g) is applied on the final inflated mesh and an edge detection algorithm (Figure 2h) is used to identify regions (Figure 2i). Based on the digitally colored sketch (Figure 2j) given by user, colors that can be applied to each region are computed (light shade to innermost regions, same shade to middle regions and darker shade to outermost regions). The suggestions (Figure 2k) are given to the user and with the help of augmented reality, user can color the paper sketch with suggested colors (Figure 2l). To achieve realism, smudging can be applied along the boundaries of regions.

We have conducted a user study with participants of different ages and various categories. Figure 4 shows some of the results of our user study with and without our interface. Even though some of the users were comfortable in drawing, they did not have any idea about shading. They found the shading assistance easy

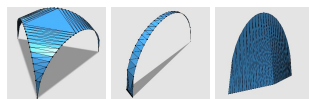


Figure 3: Surface patch template for junction triangle, sleeve triangle and terminal triangles

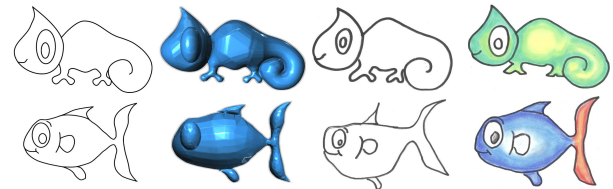


Figure 4: Results of sketching and shading given by users, (Left to Right): Input sketch, Inflated mesh, Sketch drawn by user without our interface, Sketching and shading done using our interface

to follow and were impressed to see the results. Novice users who were doing shading for the first time told that they do not know the principle behind shading and would not have generated such a result without the assistance of our system.

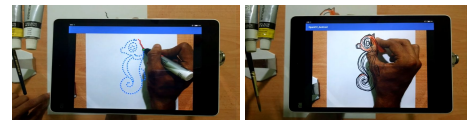


Figure 5: The overall setup of augmented reality based interface for sketching (left) and shading (right)

3 CONCLUSION

We have presented a simple “connecting the dots” approach for sketching and shading a paper sketch using augmented reality. To make shading process easy, a toon shading on a Delaunay based inflated mesh is used. The main limitation of shading algorithm is that, it assumes that the shape is circularly symmetric. As a future work, we would like to extend the shading work for more general shapes.

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