A New Style of Ancient Culture - Animated Chinese Dunhuang Murals

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1 Introduction

In this sketch we present a new artistic form based on Chinese Dunhuang culture and implement it with a set of digital techniques. The objective is to revive the ancient Dunhuang Murals both visually and animatedly, such that they become more accessible and improved. Computer models of the murals are created in a semiautomatic process. Their patterns and styles are figured with reference to Yunnan Zhongcai Painting and an advanced bump mapping algorithm [Blinn 1978] is developed in order to present the delicate material and relief effects. Moreover, a photon mapping technique implemented in our previous work [Zhu et al. 2003] is further improved in the rendering process. Our initial effort has resulted in an animation in which four classic murals are processed and animated by means we have developed.

2 About Dunhuang Murals

As one of the World Cultural Heritages located in Mogao Grottoes, China, Dunhuang Mural is famous for its centuries-old history, abundant and profound contents, and high value in fine arts. The murals are frescoed on grottoes, with the silhouettes illustrated in fuscous color, the in-between sections painted gradient, and a bright color centered to emphasize the high light. With this unique painting technique, which is called "bump means", the lighting effects of relief painting and stone carving are simulated, endowing the murals with 2.5D features. Derived from Dunhuang Murals, Yunnan Zhongcai Painting follows the convincing strokes and florid colors of the murals. With the same painting styles and techniques adopted, it focuses on portraying the scenes and characters of China's ethnic minority art and is famous for its sophisticatedly created figures.

Figure 1: Pictures of Dunhuang Mural (left) and Yunnan Zhongcai Painting (right).

3 The Modeling of Dunhuang Murals

In our work, we imitated the figures of Zhongcai and followed the "bump means" of Dunhuang Murals so that not only exquisite strokes and florid colors, but also relief features and murals textures could be displayed. We created models of the murals by first digitally photographing the paintings into high-resolution images and implementing further processing. Then the edges of the character in the image were approximated with Bezier spline curves and eventually a triangular mesh was created. The pixels occupied by the character were carefully complemented in coherence with the patterns in the image, so that the background scenes can remain complete when the character changes poses or moves in the animation. The model attributes, such as the material and texture, were defined after numerous experiments and comparisons. To best revive the characteristics of Dunhuang Murals, we decided to use bump mapping, which offers an effect of relief painting and stone carving without complex geometric structures. The photographed images helped, but were far from enough in generating the bump maps. Much more improvements should be done in order to smooth the gradient section and make each pixel raised and sunk in right manner. Moreover, a tradeoff must be made between the contrast of the bump map and the bump depth, that is, the value of perturbation made to the surface normals, in order to avoid unwanted noise. The whole scene was rendered based on photon mapping combined with traditional Monte Carlo ray tracing. Due to the nature of our work, a 2D polygonal hash table was used for quick intersection tests, such that a tremendous speedup was provided in the scenes that composed of large number of triangles. Finally an animation was produced in our custom- made software through manual generation of key frames and in-between frames were then interpolated.

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4 The Animation

In Dunhuang Murals, many short stories are told with a series of static pictures, which can be better expressed by the employment of digitalized animation. The animation displays our initial work in developing the new artistic form and effects of animated murals. In the animation, some small tricks are made in order to vividly impress the audience with a fresh representation of murals, such as an apple falling from the murals and the movement of the characters in the pictures. Right now the research is still in progress. We plan to create a complete animation, reviving the scenes in Dunhuang Mogao Grottoes and narrating the well-known stories in the murals with the means we presented above.

Figure 2: Frames from the animation.

References

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