The Needs and Possibilities of Non-photorealistic Rendering for Virtual Heritage

Hang-Bong Kang * and Yong-Moo Kwon **

** Dept. of Computer Eng., The Catholic Univ. of Korea, #43-1 Yokkok 2-dong Wonmi-Gu, Puchon, Kyonggi-Do, Korea*
E-mail: hbkang@catholic.ac.kr
*** #39-1 Hawalgog-dong, Sungbuk-ku,*
Imaging Media Research Center, Korea Institute of Science & Technology,
Seoul, 136-791, Korea
E-mail: ymk@cherry.kist.re.kr

Abstract. In this paper, we propose various levels of non-photorealistic rendering(NPR) scheme for virtual heritage. The different levels of rendering are simple feature level, semantic level and imaginative level. At the simple feature level, simple facts or features are represented. Semantics generated from relations between features and/or environmental context are represented at the semantic level of rendering. Artistic interpretation or imagination is dealt with at the imaginative level. We also discuss the needs and possibilities of various levels of NPR.

1. Introduction

With rapid progress in digital technology, virtual heritage has played an important role in the conservation, preservation, and understanding of cultural heritage [1, 2]. In representing virtual heritage, historical accuracy is important for archeologists and historians, but artistic interpretation is also necessary for education and virtual tourism. Sometimes, high precision or realism isn't always the best way to convey ideas. In particular, a simple sketch of cultural heritage may help people to understand it better because the sketch signifies salient features clearly. This means that non-photorealistic rendering (NPR) scheme is useful in the interpretation of cultural heritage.

Due to a vast number of possibilities for cultural interpretation and various possible applications for which the cultural heritage may be used, we differentiate three different levels of NPR scheme for interpreting cultural heritage. This is shown in Figure 1. The three levels of NPR scheme are

- Simple Feature level
- Semantic level
- Imaginative level

At the feature level of rendering, simple features and facts such as shape and texture are modeled and rendered by existing techniques. This gives people basic interpretation of cultural heritage.

The semantic level of rendering implies that the cultural heritage is interpreted with relations among features and recognized with environmental contexts. From rendered cultural images at this level, people can have opportunities to discover and explore the semantic information. The third level of rendering is imaginative level in which artistic interpretation or imagination is fused into the rendered images. People may be given extra knowledge to increase their curiosities and impression for cultural heritage.

In this paper, we discuss the needs and possibilities of non-photorealistic rendering scheme for virtual heritage. We propose three levels of rendering scheme to handle various interpretation of cultural heritage. Section 2 explains the needs of various levels of rendering scheme in representing virtual heritage. Section 3 discusses technical possibilities of proposed rendering scheme in understanding virtual heritage.

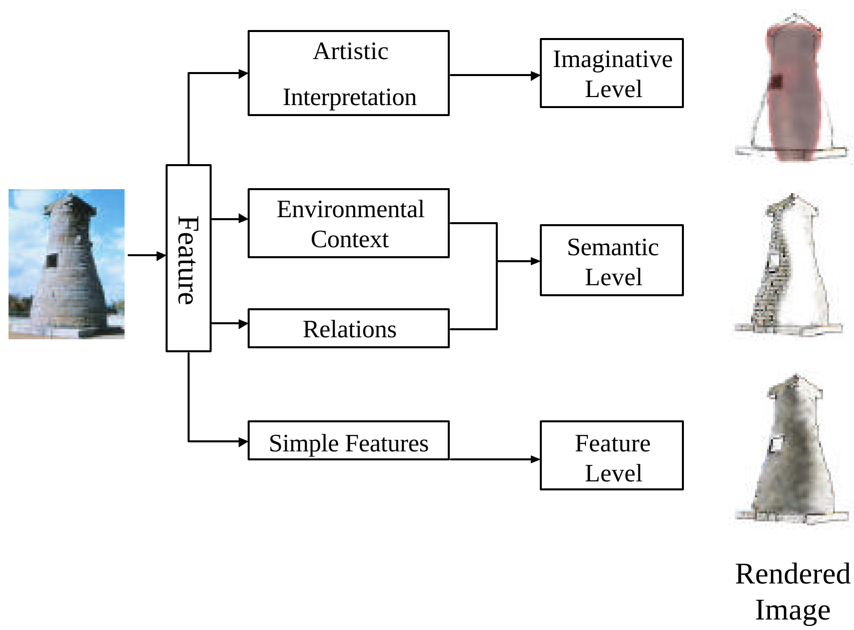

Figure 1: Various Levels of NPR scheme

2. The Needs

The NPR scheme usually uses computers to produce images that appear to have been drawn by hand [3]. Currently, a variety of techniques have been proposed on NPR or art-based rendering[4-6]. Simple features such as shape and textures are represented by strokes. This rendering scheme, so called feature level rendering, is useful to indicate salient features and applicable to represent virtual heritage on low-resolution devices or low-bandwidth networks. But, to represent complex features residing on cultural heritage and to display artistic interpretation or imagination for cultural heritage, various levels of NPR scheme shown in Figure 1 are necessary. Developing systems that are capable of producing different levels of NPR is of high importance for various applications. In this section, we will discuss some of specific needs of NPR scheme at the semantic and the imaginative levels.

2.1 Needs for Semantic level rendering

Semantic level rendering refers to the representation in which relations between features or environmental context are shown. This rendering scheme is helpful for people's understanding of cultural heritage. For example, Chumsung-Dae in Korea as shown in Figure 1 consists of layered bricks. If we use conventional NPR for Chumsung-Dae, the rendered image is that of the simple feature level in Figure 1. People can percept the shape and structure of Chumsung-Dae from the rendered image. Even though the number of layers of bricks has an important meaning in understanding the meaning of Chumsung-Dae, this concept is not represented or emphasized on the conventional NPR image. This is because the conventional rendering scheme is only interested in the simple features such as shape and structure but not the relations between features. This is shown in Figure 1. As an another example, the famous temple Bulkook-Sa in Korea consists of a number of small temples and towers. The layout among temples, towers and bridges has special meaning. However, conventional NPR cannot represent this important meaning. So, it is also necessary to represent the relations between objects on the rendered image. So, there exist needs to represent semantics at the rendering of cultural heritage.

2.2 Needs for Imaginative level rendering

Even though semantic level rendering is enough to represent the meanings of cultural heritage, another level of rendering, so called imaginative level rendering, is helpful in stimulating people's curiosities. For example, if simple impression or affection generated from cultural heritage can be reflected on the rendered image, people can draw artistic interpretation or imagination from the rendered image easily (see Figure 1). This imaginative level rendering can bridge the gap between real heritage and imaginary figures like related stories. So, the imaginative level rendering is also necessary to represent virtual heritage efficiently.

3. The possibilities

Since simple feature level rendering can be made by exiting techniques, in this section, we will discuss technical possibilities and realization schemes necessary in developing semantic level and imaginative level of NPR scheme.

Even though no concrete approaches to represent semantics and imagination for cultural heritage have been proposed yet in recent literature, one possible approach is as follows. To represent semantics on the rendered images, it is desirable to select salient features from the objects, and then to detect the relations between salient features or environmental context. The salient features refer to those that have special meanings in the interpretation of cultural heritage. Next, these features are rendered with a different style from conventional strokes. In other words, they are rendered with different line width, color or touch. By emphasizing the relations between salient features or environmental context, the semantic knowledge can be represented. The level of detail (LOD) technique in the rendered image is also applicable in the semantic level of rendering.

For the imaginative rendering, it is important to catch the impression or artistic interpretation from the cultural heritage. Once impression is captured, people can draw their own impression using interactive approach on 3D model. The impression can be represented on the rendered image by overlapping or morphing scheme with basic rendered image. Or, the impression can be reflected by geometric transformations, so impressive features or parts may have special contrast in size and tones.

In addition, the old story about heritage can be represented using all three levels of NPR in the time domain. The animation and textual information display techniques in the cartoon can be also used for the storytelling.

4. Conclusions

In this paper, we have discussed various levels of NPR scheme for virtual heritage. The NPR rendering scheme is categorized into three levels such as simple feature level, semantic level and imaginative level. The rendering at the simple feature level can be made by existing tools and techniques. The research on rendering at semantic and imaginative levels brings many challenges but may face huge difficulties. However, various levels of NPR scheme can be useful in education and virtual tourism. For future research, we hope to address the storytelling issues related with various levels of NPR scheme.

5. References

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