Objective Naturalness and Urbanness Evaluation of Animation Images

Wang Wanting, Kim Jae Ho

School of Electricals and Electronics Engineering,

Pusan National University (PNU)

ABSTRACT

In my paper, an evaluation method on naturalness and urbanness characterizations of animation image is proposed. In contrast to the prior works, we intend to give the exact degree of naturalness and urbanness by combining the low-level visual feature-based schemes with the biological visual schemes. In our method, four descriptors are extracted and pseudoinverse is adopted. By this method, we can experiment on the exact degree of naturalness and urbanness with satisfactory results.

I. INTRODUCTION

Scene categorization or classification has caught a wide interest in recent years, eg. [2]. It is a key component for many practical applications, eg., video content analysis, detection of objects and activity identification, image retrieval. In this paper, we consider the categorization of naturalness and urbanness scenes which have been focus a lot in prior works. However, aim to improve the accuracy of discriminating between two semantic categories of animation scenes (naturalness scene and urbanness scene) and get the exact values, in our method, we combine the low-level visual schemes with human being biological visual schemes.

This paper is organized as following. Section 2 the overview of naturalness and urbanness. In section 3, the proposed method is described in detail including four descriptors and the pseudoinverse. Experimental analysis is presented in section 4. Finally, it is the conclusion.

Ⅱ. OVERVIEW

In a scene, the structure always differs between urban and natural scenes. If the image is "natural" (primarily consists of natural objects), otherwise it is "urban" (primarily consisting of manufactured objects). Therefore, scenes having a distribution of edges commonly found in natural landscapes would have a high level degree of naturalness [1]-[3].

Ⅲ. PROPOSED METHOD

The basic step of proposed evaluation method is the edge detection of the scene. A result of the edge detection of the scene is showing in Fig.1.

(a)　　　　　(b)　　　　　(c)
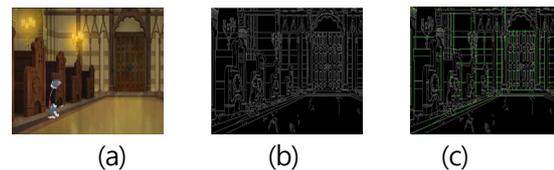
▶▶ Fig.1. (a) The original image (b) The canny edge detection (c) the result of hough transform

After the edge detections are acquired, four descriptors are supposed to be extracted for the degree of naturalness or urbanness in proposed evaluation method: (TotEDL), the number ratio of detected lines (NUMrat), the scope dispersion ratio of detected lines (SCO-DISrat) and the length ratio of detected lines (LENrat). They will be described in detail in the following parts.

1. Total Detected Lines of Edge (TotEDL)

$$TotEDL = \sum_{i=0}^{180} N(\theta_i) \qquad (1)$$

Where $N(\theta_i)$ is the number of detected lines whose scope is θ_i , $i \in [0,180]$ ($i \in$ integer). The numerical value of TotEDL is a very intuitionistic descriptor.

2. The Number Ratio of Detected Lines (NUMrat)

$$NUMrat = \frac{\sum_{i=0}^{180}[(N(\theta_i)-5)\times exist(\theta_i)]}{\sum_{i=0}^{180}[N(\theta_i)\times(1-exist(\theta_i))]} \quad (2)$$

$$exist(\theta_i) = \begin{cases} 1 & N(\theta_i) > 5 \\ 0 & N(\theta_i) \le 5 \end{cases} \quad (3)$$

3. The Length Ratio of Detected Lines (LENrat)

$$Len(\theta^j) = \sum_{i=0}^{N-1} exist_j(\theta_i)\times length_i \quad (6)$$

$$exist_j(\theta_i) = \begin{cases} 1 & if\ \theta_i = \theta^j \\ 0 & if\ \theta_i \ne \theta^j \end{cases} \quad (7)$$

$$LENrat = \frac{\sum_{j=1}^{m} exist^1 \times (Len(\theta^j)-300)}{\sum_{i=1}^{n} l_i} \quad (8)$$

$$exist^1 = \begin{cases} 1 & Len(\theta^j) > 300 \\ 0 & Len(\theta^j) \le 300 \end{cases} \quad (9)$$

θ_i is the scope of the ith detected line ($i \in [0, TotEDL-1]$ and $i \in$ integer), m is the number of different θ_i (different $\theta_i : \theta^{j \in [1:m]}$), $length_i$ is the length of the ith detected line.

IV. EXPERIMENTAL RESULTS

In order to achieve the mapping from the four descriptors to the degree of naturalness and urbanness, we apply method to get pseudoinverse factor matrix.

(a)   (b)

▶▶ Fig.2. (a) naturalness value is 2.4069.
(b) urbanness value is 2.9285

From Fig.2, it is easy to find that our method can compute the exact value of naturalness and urbanness of animation images.

Table 1. MSE

	EV' &VV	PV& EV
MSE	1.3268	0.4116

Table 1 includes the average MSE between 73 images' pseudoinverse values (PV) and 73 images' experiment values (EV) and the MSE between 13 images' experiment values (EV') and human visual values (VV).

V. CONCLUSION

Despite of some limitations, the experimental results indicate that proposed method is successful to give the exact value of animation images' naturalness and urbanness with a highly satisfying accuracy. This study has notable significance for analysis and processing of color images and movie scene.

■ References ■

[1] Aude Oliva and Antonio Torralba, "Statistics of Natural Image Categories", *Computationin Neural System*, vol.14, pp.391-412, 2003.

[2] Aude Oliva and Antonio Torralba. "Modeling the Shape of the Scene: A Holistic Representation of the Spatial Envelop", *International Journal of Computer Vision*, vol. 42, no.3, pp.145-175, 2001.

[3] Greene, M. R. and Oliva, A. "High-Level After effects to Global Scene Properties. Journal of Experimental Psychology: Human Perception and Performance", *Advance online publication*. doi:10.1037/a0019058, 2010.