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Exploring Guide Context in City Scenario Using Color and Gradient Features

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Abstract: Guide signs provide us with a remarkable amount of information about our surroundings and enables us to interact efficiently with the environment. In this paper, guidance system in a difined city scenario are explored in the image domain employing both color and gradient features. Specifically, color impression is exploited statistically based on a color difference model fusing human visual sensation and psychological perception of the designers and the guide-users. Furthermore, a gradient feature followed by a dimensionality reduction process is proposed for the deep feature extraction of signs. Our two sign features are complimentary, also of great potential for both designers and users to accomplish interaction with environment efficiently. Experiments are illustrated and the results validate our approach.

Keywords: Color impression, feature extraction, gradient feature, guide signs.

1. INTRODUCTION

Guidance system building [1] is an indispensable aspect for the development of urban construction as its great importance invision perception and communication. The main purpose of guidance system design is to embody the visualization, internationalization and humanity of interaction between imaged signs with underlying meanings and human understanding in a rather simple yet friendly way.

As it is well known that visual communication design and environment oriented identification system often employ visual symbols and graphics [2, 3] instead of applying language and words, which belongs to the category of visual design aimed at utilizing images to construct visual language. Therefore, graphic symbol is a kind of visual information, and can be classified into many categories by the way it is fixed, such as attached, suspended, put and pillar. As well, the distance and view angle are also influential factors.Recent research on city subject identity and sense of guidance system mainly focus on color sensation and cognition, while the color cognition issue is regarded as a means of identification, extraction and effectively recognition of the city oriented color via the visual image thinking cognition or orientation recognition. To solve the color impression [4] is a key problem in the color congition whose purpose is to estimate the relationship between the people and color based on color features. On the other side, image graphical features are widely studied in the domain image processing and graphics for the application of visual interaction including city guidance.

Guide signs are the most useful and popular design factors in a guidance system due to its simplification and universality [5-7]. In order to obtain good understanding of guide signs for our human, it's significant to finish sign design and analysis firstly in a reasonable system. In this paper, guide signs analysis system are discussed in the area of graphical processing and visual design for both users and designers of signs, which indicates a complete framework for city guidance and even visual interaction.

Our contribution covers two facets: A superior graphical analysis for guide sign images using fundamental gradient features and a stastical analysis based on the color features. Specifically, the gradient feature is analyzed and processed under a unified design system for evaluation of the guide signs in images. Moreover, we develop color features in the system centered with human vision and contextual features in the entire environment, color impression model is built up and the corresponding color features are extracted. Finally, experiments are given for the practical demonstration of our system.

2. IMAGE GRADIENT FEATURE

In this section, we exploit the gradient feature of guide signs selected as our representative images. The applicable strategy is discussed and the corresponding theoretical foundation is introduced based on which the experiments are illustrated in section 4.

2.1. Gradient Feature Extraction

HOG is an efficient feature descriptor proposed by Dalal & Triggs [8] for capturing the edge direction or the distribution of local intensity gradientsof objects, which means that local feature within an image can be described by the distribution of intensity gradients. As to our guide sign images, we perform three stages to extract gradient feature:

(1) Gradient computation. The first step of calculation is the computation of the gradient values. Here we calculate the magnitude and orientationat each pixel location (x, y) by equations (1) and (2).

Where and are respectively the intensity difference between each pixel and its neighbor.

(2) Spatial/orientation binning: Calculate the weighted vote according to the surrounding edge orientation at each pixel center, then cells can be derived from the accumu-

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lated vote binsso thatnot only the amount of information that the oriented gradients image possesses is decreased, nonlinearity is guaranteed. The orientation bins are spaced over 0-180 for unsigned gradients or 0-360for signed gradients and the value of bin is:

(3) Normalization and descriptor blocks:Perform histogram'snormalization using an overlapping block which is composed by some cells:

Where is an infinite simal quantity.

In our work, HOG descriptor is represented as:, where BlockFeat denotes the normalized feature value and denotes the total block number in the row while denotes the column. The parameters are set to be: RGB color space with gamma correction; the gradient of 4 cells are calculated in 9 orientation bins range from 0° to 360°, which constructs a bolck. As the resolution of our collected samples is 69 inch, where 72 dots per inch. Furthermore, cellsize is set to be 4, the dimensionality of BlockFeat is 4×9=36, so that HOG descriptorsoutput a 36×1343 dimensional feature matrix, which will be detailed in our experiment section (Section 4).

2.2. Gradient Feature Processing

In order to improve the computational complexity and detection rate, we adopt Principal Component Analysis (PCA) algorithm to further process our HOG features of guide signs. PCA is a multivariate statistical analysis algorithm [9, 10] which chooses fewer important variables from several variables by linear transformation and makes those new variables are not related while keep original information as far as possible on the reflection of subject information. The most signification advantage of PCA is to reduce the dimension of features and make the characteristic expression more compact. By applying PCA, the transformed feature samples are expected to be more irrelated, which makes the redundance greatly lower. Let be the input variables in R space, the mapping function is represented as follows:

i=1,2,

M Performs PCA in the high-dimensional feature space to obtain high-order statistics of the input variables, and in feature space F (whose dimensionality may be infinite), we assume that:

The covariance matrix in F is C:

The corresponding eigenvalue problem is:

The corresponding eigenvalue can be represented as:

These eigenvalues are optially selected in volume as the representation of from the input variables to feature space.

3. COLOR SAMPLES COLLECTION

In our work, we choose a street named Guogeli located in Harbin city as our data source and research object, based on this, our system is constructed based on color impression considering human direct visual sensation and psychological perception of both designers and sign-users.

3.1. Street Color Impression

Color impression is first computed in order to provide basic support for later scientific quantitative description. Cyan, magenta, yellow and keyplate (CMYK) model is applied, the related equipments and device include: color stilbmeter (TOPCON BM-7), spectrophotometerCM-2600d, digital camera and color cards. They are accomplished by rate stastics of main color distribution sensed by 300 people averaged in 3 age domains (24~30, 31~40, 41~50) comparing with the color cards after images are taken by camera combining color stilbmeter and spectrophotometer in good-sunny days with good visibility, glareand backlight color are avoided duringtime 9:00-11:00 and 13:00-15:00 and the distance is farther than 350mm.

The color difference model fusing human visual sensation and psychological perception is built up in 3 steps:

(1) Define the principle of sign designing from the view of designer in the stage of visual sensation and psychological perception.

(2) Gather n color samples and then to compare the samples with the standard color cards to get the relative values of CMKY color model(cyan, magenta, yellow, and key).

(3) Survey the color sensation impression from the view of users and compute the rate of each main color component.

The results are illustrated in the following tables with respect to different image targets Tables (**1**-**3**).

Table 1. Color Impression of Gogerly Street.

Hue	Hue Ratio
Gray	94%
Offwhite	3%
White	3%

Table 2. Color Impression ofBuildings on Gogerly Street.

Hue	Hue Ratio
Gray	53%
Light gray	13%
White	28%
Yellow	1%
Wathet	6%

Table 3. Color Impression ofSquares on Gogerly Street.

Hue	Hue Ratio
Green	53%
Yellow	25%
Buff	9%
White	9%
Offwhite	2%

3.2. Relationship Between Color Impression and People Age

As different people with different psychological states have great variation with respect to even the same color impression [11], therefore, color impression is then surveyed according to different age to uncover their relationship for a comprehensive feature representation in images as shown in Fig. (**1**).

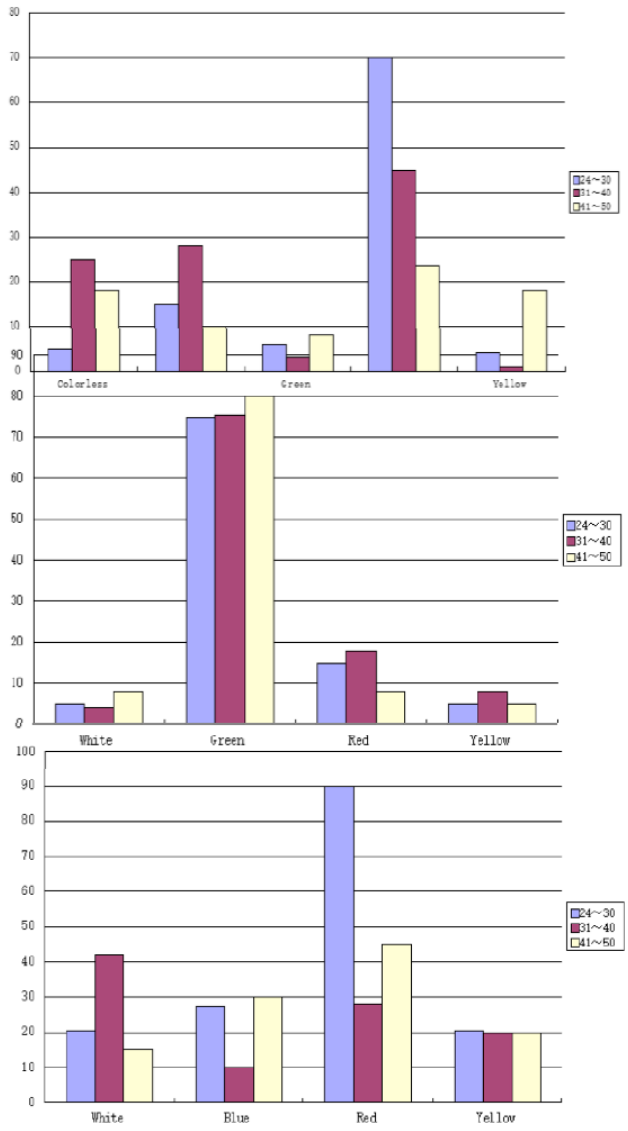

Fig. (1). Color impression of people of different ages.

4. EXPERIMENTS

In this section, we focus on exploiting gradient features of guidance city system images using HOG algorithm. Our experiments are performed in Matlab R2012a environment on a laptop with a 2.6 GHz Pentium Dual-Core CPU and a 2.0 GB RAM.

Image examples are illustrated in Fig. (**2**) and their HOG features are described in Fig. (**3**). We can see that the guidance system with different guide signs reveal obvious differences in gradient domain based on which the gradient feature can be applied as the reference for both user and designer after considering the color feature from direct visual sensation and psychological perception. As well, PCA algorithm is executed to process the HOG descriptors from 36×1343 dimensionality to 36×200 form illustrated in Fig. (**3**).

Fig. (2). Samples of city scenario.

From the above figures, we can conclude that our processed gradient features are efficient for distinguishing various typical guidance buildings or guide sign scenarios in the city environment.

CONCLUSION

Guidance system is a hot topic in the field of visual design and interaction [12]. By utilizing gradient and color features extracted from guide signs as representation, a dependable scheme is formulated in this paper. Applicable strategies and methods are elaborated and the corresponding results are given, which proves our scheme is practicable and

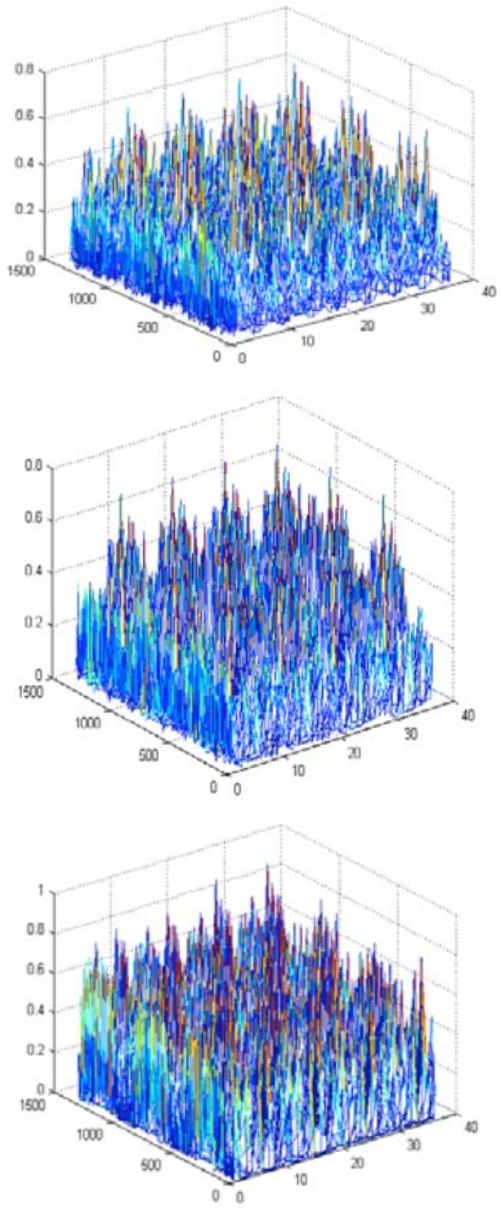

Fig. (3). HOG features of samples.

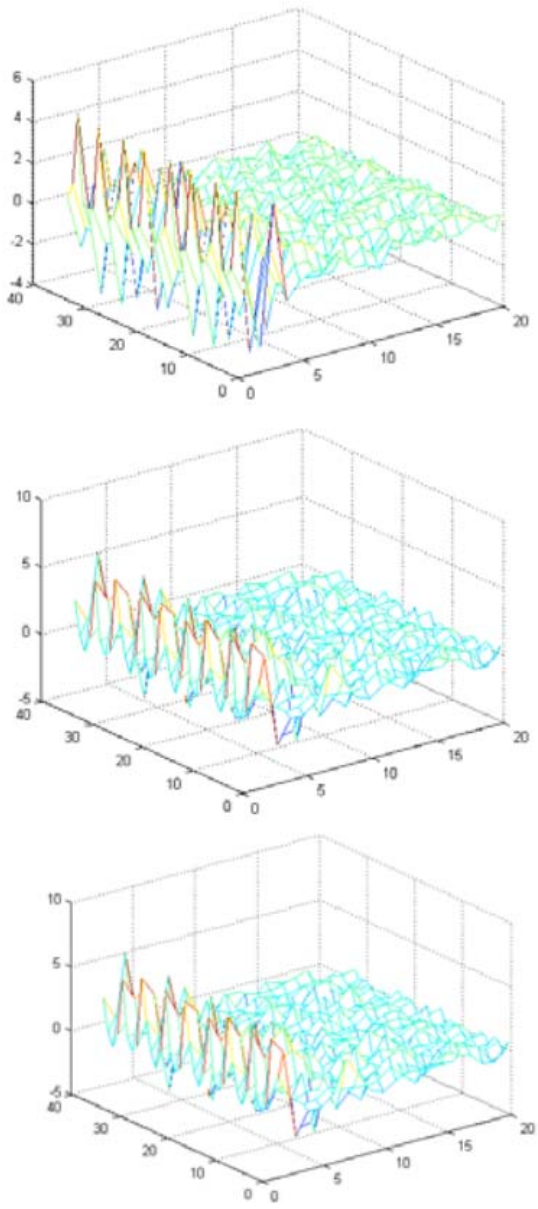

Fig. (4). PCA of HOG features of samples.

of great value for both designers and users in guidance system and even visual design system. We also believe that our approach should be tested more widely in the future to satisfy more robust needs.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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