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ANALYSES OF GRAPHICAL FEATURES OF TEXTILES BY HUMAN IMPRESSIONS

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ABSTRACT

A picture database is being created by collecting textile pictures in order to aid designers from a graphical aspect. Classification of the pictures adopts eight scales ranging each from -3 to +3 based on eight pairs of adjectives in antonyms, such as warm/cool. Our research about the classification was carried out with the data of questionnaires by some thirty inspectors for about fifty sample pictures. An aim of our research is to classify more thousands of textile pictures by a computer eye, automatically. We propose graphical features which can represent human first impressions against given pictures. The graphical features are given by each value along the scales corresponding to the pairs of adjectives, such as warm/cool. We found the warm/cool scale could be automatically calculated from the image processing. The scale can become a powerful parameter to classify most textile pictures.

INTRODUCTION

Since Saitama Prefecture produces a lot of textiles especially of silk made. A research project was proposed to manage design pictures by a computer assisted technology[1]. In order to classify pictures, we adopted eight pairs of adjectives in antonyms, such as warm/cool. The classification was carried out by the data of questionnaires to some thirty inspectors against about fifty sample pictures. Our image retrieval system uses impression scales based on the questionnaire data. The system at first displays two dimensional axes on a graphic screen. Two axes are chosen from the impression scales. A small rectangle indicates the retrieval area ranging -3 to +3 along each axis(Fig. 1).

For retrieval keys on the picture database, human impressions make an important role to extract design pictures. When a person looks at a picture, he or she will feel some emotions which can be represented by pairs of adjectives in antonym. Moreover, he or she will say such an adjective with some degrees, such as, a little, strong, great, etc. After the sample test at the questionnaire, a reduced scale is adopted for a retrieval key.

The picture database is projecting to increase more thousands of textile pictures. An aim of our study is to classify those pictures by a computer eye, automatically. Coloring characteristics in design pictures are adopted so as to extract sensuous information in the pictures[2][3][4]. In addition to the coloring characteristics, we adopted more two characteristics, pattern characteristics and composition characteristics.

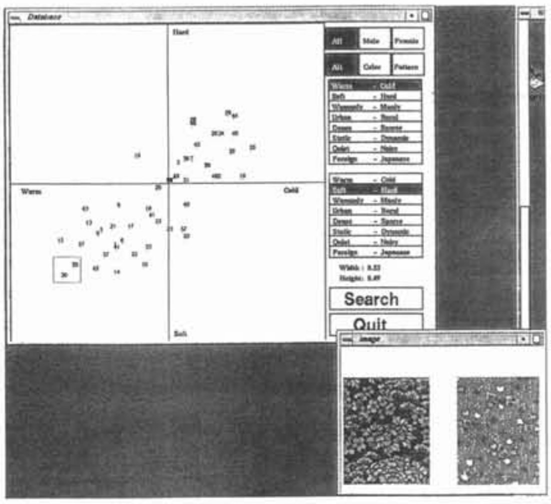


Fig. 1: Textile pictures database system

A METHOD OF CLASSIFICATION ON IMPRESSION SCALES

Classification of the pictures based on the impression scales is extraction of sensuous information in the pictures. In order to classify digitalized images, textile pictures have to be characterized by impression scales accounting two features, graphical features and impression features(Fig. 2).

Table 1 shows eight pairs of impression scales. Each impression scale is composed of a pair of adjectives in antonym ranging -3 to +3. The values 1, 2, and 3 correspond to the sensuous grades, a little, more, and the most.

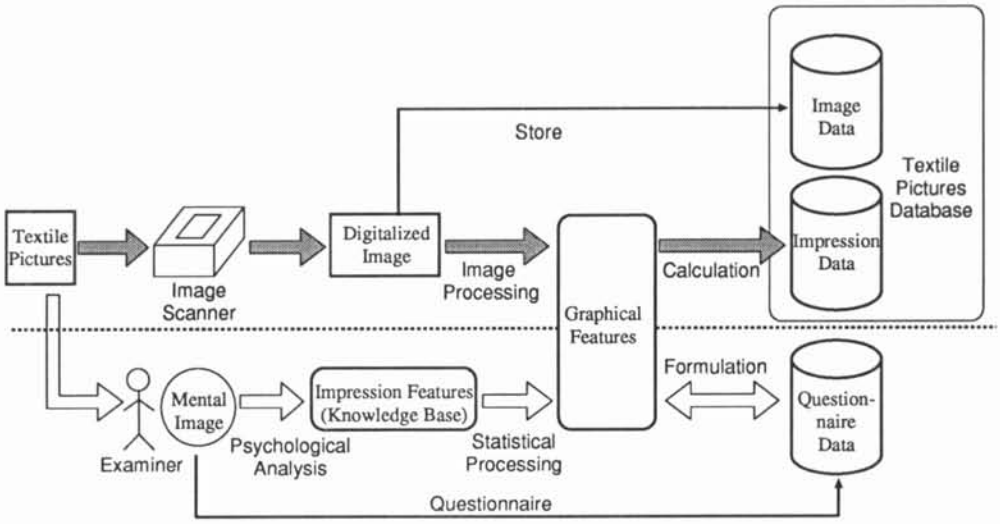


Fig. 2: Creation of textile pictures database

Table 1: Impression scales

warm	⟷	cool
soft	⟷	hard
girlish	⟷	boyish
town	⟷	country
dense	⟷	sparse
static	⟷	dynamic
quiet	⟷	noisy
foreign	⟷	domestic

Each impression feature decides a value along an impression scale. Two features are expressed by words from psychological analyses. The graphical feature is calculated by image processing on the digitalized images. The textile pictures are digitalized by a color image scanner into 500KB in maximum, and stored in a harddisk. The digitalized images are analyzed by following procedures;

1. find out relations between an impression scale and the impression features,
2. replace the impression features to the graphical features in images,
3. calculate the graphical features of images by procedures of image recognition,
4. fix a relation of the graphical features with the impression scale accounting the score of questionnaire, and
5. calculate a value of impression scale using the values of graphical features.

ANALYSES OF IMPRESSION FEATURES

The first step of automatical classification of textile pictures is to analyze impression features in psychological analyses. The original textile pictures under the test are kept in Saitama Textile Research Institute as of the most standard design. The impression features corresponding to impression words(Table 2) are classified into more three sub features; pattern features, coloring features and composition features. It was found that an impression feature about 'quiet' is similar to the one about 'static', and another impression feature 'noisy' is similar to 'dynamic'. It was difficult to choose the words that can express impression features about town/country and foreign/domestic scales, because impressions for those scales mainly depend on individual human experiences.

GRAPHICAL FEATURES

The sample pictures for questionnaires were supplied by original textiles or designs drawn on paper. The pictures are then digitalized into 3×8 bits full color pixels by a color image scanner. The graphical features are calculated by image processing on the digitalized images. We proposed graphical features in Table 3. Among eight species of graphical features in Table 3, we will here explain in detail about the ratio of curved shapes and the distinctive colors.

Table 2: Impression features

Adjectives	Pattern features	Coloring features	Composition features
warm	curved, round	warm-colors	
cool	linear, angular	cool-colors	
soft	curved	low contrast	
hard	linear	high contrast	
dense	complicated	more coloring	
sparse	simple	less coloring	
static	monotonous	low contrast	stable composition, symmetrical design
dynamic	modulated	high contrast	unstable composition, asymmetrical design
girlish	monotonous	low contrast	
boyish	modulated	high contrast	

Table 3: Graphical features

Graphical features	Relation to impression features
complexity of lines	complexity of shapes
number of blank holes	complexity of shapes
ratio of curved shapes	curved or straight shapes, round or angular shapes
number of color species	more or less color species
distinctive colors	warm or cool color species
contrast of coloring	low or high contrast
geometrical distribution of contrasting	complexity of shapes, stable or unstable composition, symmetrical or asymmetrical design
geometrical distribution of colors	stable or unstable composition, symmetrical or asymmetrical design

The ratio of curved shapes is calculated from the following procedures;

1. smoothing of pixels, while keeping edge properties,
2. reducing true color images to gray scale images,
3. extraction of edge lines using Robinson operator,
4. emphasizing the image contrast by binarization,
5. thinning of thick lines, and expressing them as vector data, and
6. comparing the difference between the length along polygonal lines and those short cut length. The difference of length is added together into a reference length.

If the reference length becomes larger, the picture has a lot of curved lines. People generally feel "warm" when looking at pictures with colors of red or orange, and "cool" at the blue or purple color. They also feel cool when looking at more monochromatic colors. Pictures with a lot of color species have normally high Value or Chroma in the HVC space, and they feel warm impressions.

The distinctive colors is calculated from the following procedures;

1. dividing the images into checkered patches, and computing average colors at each patch,
2. calculating Hue, Value and Chroma(HVC) at each patch,
3. calculating a degree of warm by Hue, and for monochromatic pictures, a degree of cool from Value or Chroma.
4. reducing the degree of warm accounting Value or Chroma,
5. increasing the degree of warm accounting the conspicuous colors[5], and
6. summation all the degrees of patches.

If the amount of distinctive colors is positive, it means 'warm', and if negative, 'cool'. The absolute value correspond to the degree of warm or cool.

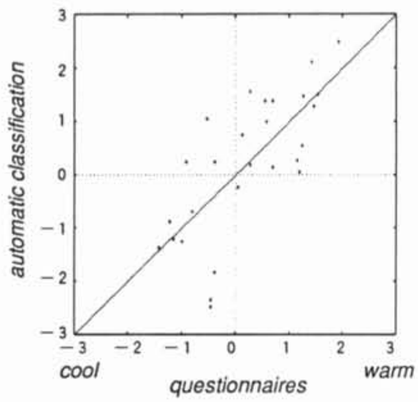


Fig. 3: Correlation between human sense and computer eye

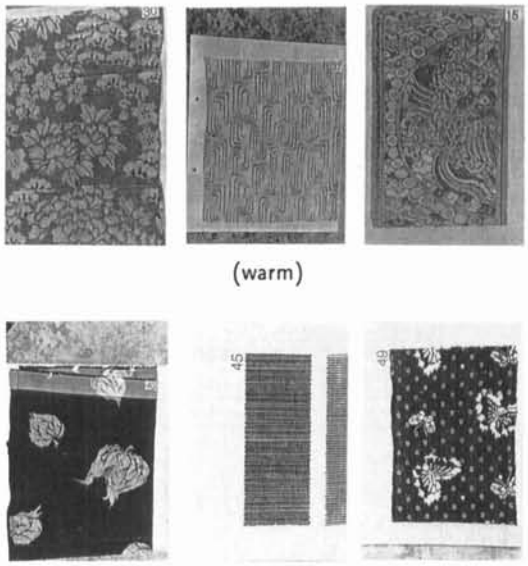
AUTOMATIC CLASSIFICATION OF PICTURES AT THE WARM/COOL SCALE

We classified textile pictures using the warm/cool scale which mainly influence to the two graphical features; the ratio of curved shapes and the distinctive colors. We chose each a half number of sample pictures at random for human inspection and for digitalized analyses in order to statically compare two results and to obtain a reasonable parameter. The parameter plays to analyze pictures automatically and to meet with the same effects as tested by questionnaires. Fig. 3 shows correlation between human sense by the questionnaires and a computer eye. The vertical axis shows automatic classification and the horizontal axis shows questionnaires. The positive value means warm, and negative means cool. The data of questionnaires are the mean value about some thirty people, such as designers, students, etc. A correlation coefficient was about 0.73 between the values of automatic classification and of questionnaires. Fig. 4 shows some sample pictures in automatic classification along warm/cool scale. Some deviatiôn occurred between the automatic analyses and the human questionnaires on the following characteristics.

1. The ratio of curved shapes is calculated more stronger than human feeling because the materials fiber will emphasize edge effects in image processing.
2. Colors in gold or silver are not correctly transferred by an image scanner.

CONCLUSIONS

An aim of our study is to make a computer understand as similar as the human sense, and to decide a retrieval key for a target picture. We found the warm/cool scale could be automatically calculated from the image processing. The scale can become a powerful parameter to classify most textile pictures.



(warm)

(cool)

Fig. 4: Sample pictures corresponding to the warm/cool scale

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