The Recognition of Color and Texture Features Based on the Senses of Vision and Touch

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Abstract

As the most widely used material in footwear, leather has its unique texture and hand feeling which could improve the quality of the products. On the basis of Kansei Engineering, this study analyzes the features of shoe leathers, including colors and textures, and then expresses the vision and visual-tactile imagery of the consumers on the types of leathers through articificial neural network verification. This paper also provides suggestions for footwear designers and the leather manufacturers on the design and selection of leather to accelerate the design flow, to assist the designers with the selection of the suitable materials in an objective way, and to promote the innovative competitiveness of the footwear eventually. This study firstly lists the representative words of the consumers on vision and visual-tactile sense perception on leather of footwear, and makes a quantitatively compilation about the vision and visual-tactile sense perception. What's more, a program is written to capture the essential color and adhesion degree of the photo colors of these leather samples as color features. Then, the gray-scale values of the image are analyzed, and the related computational methods of LBP, SCOV, VAR and SAC are put forward on the basis of pixel eight-neighborhood to capture the textural features of the images. Taking the captured eigenvalue of color and texture as input layer and the quantized values of the perceptual words as output layer, The specific achievements of the study are as follows: a better Kansei engineering and articificial neural network training method of shoe leather is proposed, and an aided design flow of shoe leather with perceptual words and back propagation articificial neural network are worked out.

Keywords: Human computer interaction, Kansei engineering, articificial neural network, color feature, texture feature

Introduction

Leather is one of the materials commonly used in shoes. It is superior to other materials in color, texture and production process.Leather-made leather shoes are the expression of taste and status in people's evaluation. The leather has unique texture and touch after being made. Different types of leather have different textures and touches. After artificial processing, leather can also be used. Forming a color style that is not used, leading the fashion.With the changes in the economic environment, the footwear industry has also seen many changes and competition.Workers' wages are rising, the number of children is lost, labor is lost, factories are moving outside, and environmental pressures are challenging the shoe-making enterprises.In order to survive and develop in today's fiercely

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competitive environment, shoe-making enterprises are bound to face an upgrade and transformation.The top priority of the upgrade and transformation is to seize the market to enhance R & D and innovation capabilities.The upgrade and transformation needs to rely on innovative design to expand the market, and the consumer's emotional psychology tends to be an important factor in market decision-making, and also a key reference for design.Therefore, grasping consumer psychology is especially important for designers and enterprises.Among the factors affecting the type, color, material, quality and function of product factors, the material can influence the sensory effect of the design is a key factor that cannot be ignored.However, at present, the materials selected by the designers are mostly based on their own experience and aesthetics, which is different from the perception of consumers.How to grasp the consumer's psychological feelings about the product and make it close to the goal to be achieved is a question worth considering.With the development of computer software technology, it is expected to numerically select leather materials for shoe materials to explore the relationship between the corresponding sensibility vocabulary values and the color features and texture features of the leather itself.

Objectives

Based on the sensibility engineering, this study obtained the visual and tactile sensibility evaluation of the leather samples of the shoes, and quantified the visual and visual sensibility of the leather samples of the shoes, and the color characteristics obtained by the image processing. The value and texture eigenvalues are used as the input layer, and the perceptual vocabulary score is used as the output layer. After training through the Back Propagation Neural Network (BPN), the obtained model is used as the basis for testing the new leather samples later. The preferred neural network training results are verified.

The research objectives of this paper are as follows:
1. A parameter conversion method for the leather color characteristics and texture features of the shoe is proposed.
2. A better shoe leather sensibility engineering and neural network training method is obtained. The inverse transmission neural network is used to learn, and the leather traits auxiliary design process based on perceptual vocabulary is established to improve design efficiency and reduce innovation. risks of.

Theory

Nagamachi (1995) proposed three models of sensible engineering, in which Computer Aided Kansei Engineering System is a computer system that uses computer operations to input sensible vocabulary and convert customer's sensory image into design details. .In the following research, some scholars added fuzzy theory, neural networks, gene algorithms and other logical inferences, combined with the perceptual database to form an expert sensible evaluation system.In related research, Hsiao, Chiu & Lu (2010) used the Kansei Engineering System (KES) to transform the consumer's psychological thoughts into the quantification of image vocabulary: using GA optimization features to arrange all the components together. Compare it with the predictions beforehand, find all the optimal combination models that match their image, and show the 3-D product shape in CAD, and assist the designer in the development of the concept and design.

The learning calculus commonly used in the inverse transfer neural network (BPN) is the Error Back Propagation (EBP), which is the intrinsic correspondence between the input value of the learning training sample and the target output value. The learning sample is learned through the hidden layer design. The intrinsic correspondence between

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the input value and the target output value is obtained by comparing the output value with the original target value of the training sample to obtain the error of the network, and the error is determined by the concept of the Gradient Steepest Descent Method. The function is minimized so that the network can apply the concept of the steepest slope to correct the network weights (weights and partial weights).

The Semantic Differential method was created by the American psychologist Osgood et al., and is mainly used to study the subject's sensory imagery of various product samples (Osgood, 1990), which is a kind of description method.The attitudes of respondents to an object or concept are measured by the scale of adjectives that are opposite in meaning.The main purpose is to help the researcher understand the positive and negative imagery feelings and preferences of the subjects, and is usually used to evaluate non-quantitative data.The semantic difference method consists of three elements: things, scales, and subjects.Things refer to the objects of research, which can make specific things products or abstract concepts; scales include pairs of opposite adjectives and scales, where adjectives must be meaningful or relevant to the assessment, and the subject needs to be It is easy to understand; subjects need to be screened according to research requirements, including age, gender, occupation, and consumption level.

Cluster Analysis is a multivariate statistical method. The purpose is to collect similar parts in the same cluster in a mess of data, so that the things in the group are highly homogenous and the ratio of variation is changed. The smallest, and the different clusters have a high degree of dissimilarity.Han (2011) and other studies pointed out that cluster analysis and classification are not the same. Cluster analysis does not need to define category labels, and clusters are classified into new categories according to cluster characteristics.Cluster analysis requires the calculation of similarities or distance values between data, categorizing data by degree.Cluster analysis is often used as a processing step before other research methods in research topics such as image processing and graphic recognition.

The K-means clustering method (K-Means for short) is a distance-based cluster analysis and is one of the most typical and common methods.The distance using the data value is used as a discriminant index of similarity, that is, the closer the distance between the two data is, the higher the similarity is.This algorithm is simple in structure and can process large amounts of data and is fast.

The focus group is a qualitative research method and one of the most used research tools in the social sciences.In the past, managers used the focus group approach to test consumer responses to marketing methods or new ideas for design (Stewart and Shamdasani, 1990).The Focus Group Act calls for organized groups to focus their discussion on a single topic.Focus group laws allow researchers to participate in discussions and guide observations, and to be more intimately exposed to research topics.Participants are encouraged to exchange ideas and express opinions. They have an interactive form, can collect a wide range of materials, and trigger a deeper and broader topic discussion from a pluralistic perspective.Researchers can gather specific required data for research topics in a relatively short period of time.

Methodology

First-level In this study, the leather sample book provided by Yixing Shoes Co., Ltd. samples the leather sample number according to the order of the leather sample book. The random number can prevent the samples from being close to each other during the perceptual questionnaire survey, making it difficult to confuse the questionnaire test. Divided into: bead skin, waxed skin, embossed skin and broken oil skin four types, after photo collection.In order to obtain information on the sensory image related to the leather

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samples of shoes, 80 adjectives suitable for describing leather were collected from popular fashion magazines, leather-related books and online.80 pieces of skin sensation related to the leather image of the initial collection were collected, and the focus group discussion was carried out in conjunction with the leather of the shoe. After discussion by experts, the relevant sensibility vocabulary for the leather visual and visual touch of the shoe was found.The steps of the focus group method are summarized and summarized.After selecting 10 groups of leather visual and visual tactile sensibility vocabulary, a perceptual assessment questionnaire was designed.The questionnaire is for the students of the design department of Donghai University. The students of the design department have a more delicate observation and feeling of things, and can make appropriate perceptual evaluation of color and texture.And 10 random investigators can reflect the intuitive feelings of consumers and reflect the perception of some consumers.The visual perceptual survey is the same as the population of the tactile sensory survey.According to the results of the emotional impression scores collected by the visual perceptual questionnaire and the visual tactile sensibility questionnaire, the average value of the scores of the 10 groups of visual sensation vocabulary for each sample and the average of the scores of the 10 groups of visual sensibility vocabulary were obtained. The average value was divided by 7 (in the image sensory scoring experiment, the perceptual score was 7th order), and its value was normalized, and its value was between 0-1 for neural network training.The shooting equipment uses the Canon EOS 650D to shoot in natural light with sufficient light. The platform is set at 20° to the tabletop, and the camera lens and the platform are at an appropriate angle to the platform.The camera is set to a focal length of 135, an aperture of 5.6, a shutter of 1/30, an IOS of 800, and a photo size of 5184 × 3456 pixels.After the shooting, the editing is performed by Adobe Photoshop software.Take 160X160 pixels of the photo center as the image required by the image feature capture program.The RGB values of the 160x160 pixel image of the leather sample are converted into HSI values, and then the hue (H) chroma component (S) and the luminance component (I) are decomposed, respectively, for color analysis and texture analysis, to extract the color features of the leather sample. With texture features.Using SPSS software to analyze leather data, leather image data analyzed by LBP, SCOV, VAR and SAC methods will have 4 different texture data, 4 texture features each with image color features, 54 leather The data obtained from the swatches are divided into 5 groups by the K-Means method, and representative samples of each group can be obtained, which is convenient for finding each group center sample.This study is divided into three types of 17 training types according to the different input layers of the inverted transmission neural network.

Literature Review

In leather related research, Ma, et al. (2007) studied the interface design and usability effects of custom color combinations for leather sofas and fabric sofas.Using the results of experimental research to design the interface of color selection of customized leather sofa products, and to investigate the color image of consumers, using Fuzzy Level Analysis (FAHP) to develop a kind of auxiliary decision, which can determine the priority order of candidate solutions. Auxiliary decision mode.

Related neural networks in the study of footwear, Wang et al. (2016) proposed a set of sneaker design process based on sensible engineering and neural network, self-organizing by neurological unsupervised learning The distribution map of the Self Organizing Map (SOM), the ability to automatically search the clustering rules between the sneakers and the NBA basketball star, and then verify the learning effect with the reverse transfer neural network (BPN), so that the designer can This model is used as the basis for the design of customized sneakers.

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Ludden, Schifferstein & Hekker (2009) pointed out in cognitive research that vision can provide people with the most information in the shortest time and help people understand things. Vision can usually be perceived before touch, and the distance limit it accepts is relative to The touch is broader.The biggest factor in attracting consumers to products is visual appeal.Stadtlander & Murdoch (2000) pointed out that in identifying and describing product features, essentially 60% are obtained through visual senses and 32% are obtained through tactile senses.It can be seen that most of the people who obtained the evaluation production can be completed by visual and tactile, and the two complement each other. This study is based on the sensory mode of visual touch.

Pass et al. (1997) proposed the Color Coherent Vector (CCV) method to improve the shortcomings of the color bar graph. Based on the color bar graph processing, the color space information is also considered to extract the color of the image. feature.The area with the same color is called the "adhesive area", and the degree to which a certain color is in the adhesive area is defined as the "adhesion" of the color.The pixels are classified into two types of measurable pixel adhesions, adhesive and non-adhesive. The adhered pixels are in a certain continuous area, and the non-adherent pixels are not in this area.The color adhesion vector is a classification that can represent each color in the image.

In the study of color and texture, Huang (2016) uses the luminance image of HSV color space to analyze the texture features of the face using different sizes of LPB operators, and analyzes the gradient direction with Sobel operator to obtain the features. The detection shooting tool analyzes the difference between the face and the printed face.

Yang Donghan (2016) proposed a tracking algorithm for the spt-lbp method.The super-pixel tracking method is used to add texture features to improve the tracking success rate of gray-scale images, and the observation results are weighted to reduce the interference and improve the reliability of the optimal solution.It demonstrates robust tracking in color and grayscale image testing.

Wu Junlong (2004) compared the different window size texture information effects of Landsat TM images, using 7×7 windows to construct knowledge base image texture information.Use color tone and saturation to build knowledge base image color information.The knowledge base adds texture and color information to the auxiliary classification to improve accuracy.

Findings

In this study, the average error rate of the test samples after verification was compared by using the perceptual neural network trained by different input and output layers, Organized as shown in Table 1.

Table 1
Comparison of error rates of 17 types of inverted transmission neural networks

Input Layer	Output Layer	Average Error Rate
Color feature		29.07%
LBP Texture feature		36.88%
SCOV Texture feature	Visually sensitive quantified value	29.27%
VAR Texture feature		33.20%
SAC Texture feature		25.21%
LBP Texture feature	Tactile	21.35%

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Input Layer	Output Layer	Average Error Rate
SCOV Texture feature	sensibility quantified value	19.79%
VAR Texture feature		21.31%
SAC Texture feature		22.08%
Color feature + LBP Texture feature		22.37%
Color feature + SCOV Texture feature	Visually sensitive quantified value	18.94%
Color feature + VAR Texture feature		18.62%
Color feature + SAC Texture feature		26.47%
Color feature + LBP Texture feature		16.45%
Color feature + SCOV Texture feature	Tactile sensibility quantified value	16.96%
Color feature + VAR Texture feature		14.50%
Color feature + SAC Texture feature		18.86%

In the training error value of the neural network, setting the error rate within 20% is a good training result.In this study, the scov texture feature is taken as the input layer, and the bpn-b6 error rate of the tactile inductive quantized value as the output layer is 19.79%.The color feature is matched with the scov texture feature as the input layer, and the visual inductive quantized value as the output layer has a bpn-c2 error rate of 18.94%.The color feature is matched with the var texture feature as the input layer, and the visual inductive quantized value as the output layer has a bpn-c3 error rate of 18.62%.The color feature is matched with the lbp texture feature as the input layer, and the bpn-c5 error rate of the tactile inductive quantized value as the output layer is 16.45%.The color feature is matched with the scov texture feature as the input layer, and the bpn-c6 error rate of the tactile inductive quantized value as the output layer is 16.96%.The color feature is matched with the var texture feature as the input layer, and the tactile inductive quantized value as the output layer has a minimum bpn-c7 error rate of 14.50%.The color feature is matched with the sac texture feature as the input layer, and the bpn-c8 error rate of the tactile inductive quantized value as the output layer is 18.86%.

Discussion

In this study, the software of Matlab software was used to analyze the image of leather samples, and the color characteristics and texture features (LBP, SCOV, VAR and SAC) of the images were obtained. Then, the inverse neural network training was carried out through Matlab software.The data obtained from the leather samples was used as an input layer for neural network training, and visual inductive quantized values and visual tactile inductive quantized values were used as output layers.In this study, the average error rate after test samples were compared and analyzed by the perceptual neural network trained by different input layers.

From the neural network of different input values, it was found that adding color features is helpful for verifying the results.The possible reason is that the color feature with the texture feature can comprehensively analyze the characteristics of the leather piece.From the neural network of different output values, it is found that the visual tactile verification result is superior to the visual verification result.The possible reason is that

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when the perceptual questionnaire is used, the subject touches the leather piece, which increases the feeling of the subject's material on the leather, so the error rate of the inverted neural network is reduced.

In general, the input layer of the preferred inverse transfer-like neural network model should contain color features and texture features, excluding bpn-b6.The input layer of the preferred inverse transfer-like neural network model should use the visual tactile inductive quantized value as the output layer, excluding bpn-c2 and bpn-c3.In bpn-c5, bpn-c6, bpn-c7 and bpn-c8, the error rate of bpn-c7 is at least 14.50%. Therefore, the better inverse-transfer-like neural network training model should match the var texture feature with color features. The input layer is used as an output layer depending on the tactile inductive quantized value.

Limitations

The scope and limitations of the study are as follows:
1. The leather samples of the shoes must be available and representative on the market: the classic shoes provided by the shoe company or the leather samples of the hot shoes, which are the styles used by the designer of the shoe due to the season or the trend, reflecting the market. Dynamic needs and designer experience.
2. Sensual Questionnaire Group Setting: Part of the design department students, the design department students have a more detailed observation and feeling of things, and can make appropriate perceptual evaluation of color and texture.Some are random consumers, which can reflect the intuitive feelings of consumers and reflect the perception of some consumers.The study is unable to comprehensively collect a large number of subjects under investigation.

Recommendation

In general, the input layer of the preferred inverse transfer-like neural network model should contain color features and texture features, excluding bpn-b6.The input layer of the preferred inverse transfer-like neural network model should use the visual tactile inductive quantized value as the output layer, excluding bpn-c2 and bpn-c3.In bpn-c5, bpn-c6, bpn-c7 and bpn-c8, the error rate of bpn-c7 is at least 14.50%. Therefore, the better inverse-transfer-like neural network training model should match the var texture feature with color features. The input layer is used as an output layer depending on the tactile inductive quantized value.

There are still many limitations in the research process that have not been fully considered and improved in time.Therefore, the following suggestions are proposed here as a reference for future related research.

Market information is changing rapidly, and consumers may feel different with the seasons and trends.In order to make the results of this study more effective for footwear designers to refer to, it is necessary to extensively collect leather samples from different seasons and different parts of use. Joining the research and discussion, the training results of this study can be more perfect and increase its utility.

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