Clothing Pattern Recognition for Blind using SURF and combined GLCM, Wavelet

Manisha Dhongade

[1] Pune Institute of Computer Technology, Affiliated to SPPU, Pune, Maharashtra, India

Abstract: *Recognizing clothing pattern and color is challenging assignment for blind person. The system to take care of this issue is proposed here. Using HSV (hue, saturation and value) color space, dominant color in clothing image is identified. To recognise the clothing pattern SURF (speedup robust features) and features extracted by applying GLCM(gray level co-occurrence matrix) on image sub band obtained after DWT(discrete wavelet transform) are used. Recognised cloth pattern and color are conveyed verbally to user. Proposed work increases the clothing pattern recognition accuracy.*

Keywords: Classification; DWT; Pattern recognition; SURF

1. Introduction

According to the WHO (World Health Organisation) 285 million people are visually impaired people all over the world. Wearing clothes of suitable colour and pattern is important in modern society. Blind people do this task either with the plastic Braille label attached to clothes, or by taking help of their family members.

Plenty of research has been done in the field of texture recognition. But it won't be applicable for cloth pattern recognition as there is large intraclass pattern variation in clothing pattern. To deal with this there is need to use combination of local and global features for classification. Local features gives information about the discriminant image patches .But within a same class they may vary. Global features are extracted by considering entire image are stable within same category. Though Global features are compact, they are sensitive to occlusion and clutters. Local and global features combine can give better result in cloth pattern classification.

This paper is organized as follows. In section II, the literature survey on texture analysis methods and assistive techniques for blind people is discussed.Feature extraction for pattern recognition is included in section III.The details of Clothing color and pattern identification are demonstrated in Section IV. In section V, experimental results are discussed. Section VI concludes the paper.

2. Literature survey

Different kinds of assistive systems have been developed to make life of blind people easier like bank note recognition, navigation assistance system [1]. Various research has been done in the field of texture recognition, to make recognition task robust to view point change, rotation, scaling and occlusion. However along with this to recognise the clothing pattern, intraclass variation has to be taken into consideration [2], [3].

J. Rose [4] proposed a method to attach the RFID tags to the clothes. Information about the clothes was stored in online database maintained by fashion expert. Using the handheld device, information about the clothes can be read. Blind user can pick matching clothes with the help of the online database.

Liu *et al.* [5] proposed system which would recommend the clothes suitable to occasions. The system is useful for the person with the normal vision.

Y*i*uan *et al.* [6] proposed a method which will tell blind user whether the two clothing images are of same pattern and color .Pattern of the clothes images are not recognised by it. Y. Tian [7] Recognition of clothing pattern with reduced set of feature. Zang *et* al [8] combined scale invariant feature transformation (SIFT) and spin for texture classification. X. Yang [9] recognizes clothing patterns using SIFT, DWT and Radon Transform feature in four categories and identifies 11 clothing colours. City college of New York (CCNY) clothing pattern dataset[media-lab.engr.ccny.cuny.edu/ data] is used

In this paper, clothes patterns are classified either into one of the four categories: stripe, plaid, plain and patternless. For recognition SURF (speedup robust feature) ,more compact, robust to SIFT [10] is combined with feature extracted by applying GLCM on images obtained by DWT. The four categories are able to meet the basic requirements.

3. Feature Extraction for Clothing Pattern Recognition

Global features captured from DWT+GLCM are combined with SURF local features. The concatenated vector is given as an input to SVM (support vector machine).

3.1. SURF (speedup robust features) bag of words
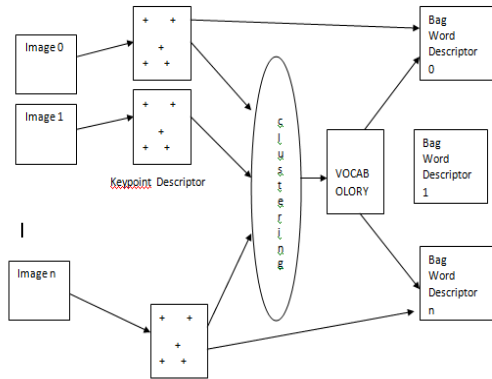
Figure 1: Bag of Word Model [11]

3.1.1 Calculate feature

SURF(speedup robust features) is an algorithm in computer vision to detect and describe local features in images. The algorithm was published by H. Bay[10],in 2006 . Key locations are defined as maxima and minima of the result of difference of Hessian-based function applied in scale space to a series of smoothed and resample images. Feature vector is of 64 dimensional.

3.1.2. Cluster Feature:
Features are then clusters using k-mean algorithm. Centroid of the cluster is used to generate vocabulary.

3.1.3. Create the bag-of-words histograms

All the raw SURF descriptor need to mapped in an image to its visual word. Each raw descriptor is assigned to the word vector (cluster center) it is nearest to in terms of Euclidean distance. The histogram is creted which will represent frequency of occurrence of codeword in image.

3.2 DWT+GLCM based feature extraction:

3.2.1. DWT (Discrete wavelet transform): Discrete wavelet transform is a weighted sum of waveletψ(n) and scaling function Φ(n).

$$W_{\psi}(m.n)= \frac{1}{\sqrt{MN}}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x, \psi^{i}(x.y) \quad (1)$$

Where i={H,V,D}
$\Psi^{H}(x.y)= \Phi(x). \psi(y)$
$\Psi^{D}(x.y)= \psi (x). \psi(y)$
$\Psi^{V}(x.y)= \psi(x). \Phi(y)$

$$W_{\Phi}(m.n)= \frac{1}{\sqrt{MN}}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x, \Phi(x.y) \quad (2)$$

In dwt transform[12], image is decomposed into 4 subband elements HH,HL,LH and LL as show in fig.2. LL contains compressed version,HLcontains vertical edge details of image,LHcontains vertical edge details.HHcontains diagonal edge details.
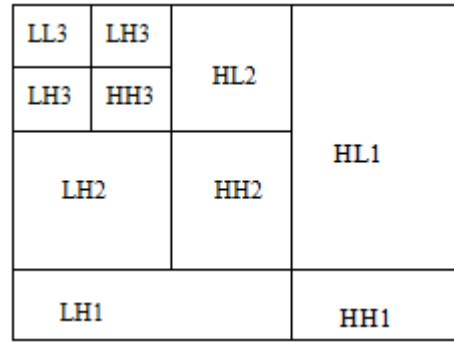
Figure.2: DWT Decomposition of image till level 3[13]

3.2.2. Gray Level co-occurrence matrix (GLCM)
The GLCM functions gives how many times pairs of pixel which are in spatial relationship and with certain intensity values are occurred in image and then extracting statistical features from this matrix.

3.2.3. DWT+GLCM integration
This will help to increase accuracy of classification by distinguishing between true and false edges. Following features are extracted after applying GLCM on each image sub band extracted from DWT,

$$\text{Energy}= \sqrt{\sum_{i=0}^{L-1}\sum_{j=0}^{L-1} p^{2}(i,j)} \quad (3)$$

$$\text{Variance}=\sum_{i=0}^{L-1}\sum_{j=0}^{L-1}(i-\mu)p(i,j); \quad (4)$$

$$\text{Uniformity}=\sum_{i=0}^{L-1}\sum_{j=0}^{L-1} p^{2}(i,j) \quad (5)$$

$$\text{Entropy}=-\sum_{i=0}^{L-1}\sum_{j=0}^{L-1} p(i,j)\log(p(i,j)) \quad (6)$$

Where, $z_i$is the element of GLCM, P (zi) is coefficient at location z_i.

Energy measures repetition of pixel pairs. Energy will be high if pixels are similar to each other. Variance will add more weight to element which varies from average intensity value. Entropy measures distortion.Uniform tone images have entropy near to zero.

3. Clothing Colour and pattern Recognition System
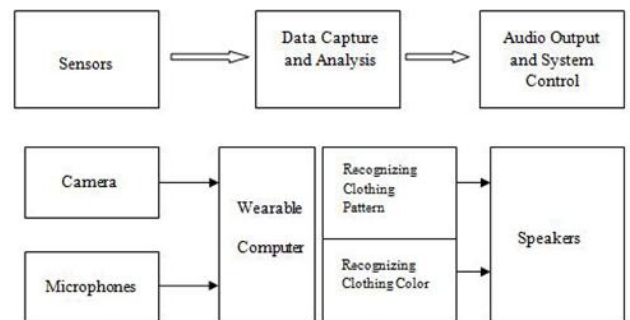
Figure 3. Clothing pattern recognition system architecture design [9]

The system contains three major components (see Fig 3): 1) Sensor including a camera for capturing clothing images. Microphone for speech command input, speakers for audio output;2)data analysis to perform clothing color and pattern identification which can be a desktop or smartphone);3)audio

output to provide recognition results of clothing pattern and color.

4.1 Clothing Color Identification

In the HSV system, the hue of a color is its angle measure on a color wheel. Pure red hues are 0°, pure green hues are 120°, and pure blues are 240°. V is brightness. Intensity is the overall lightness or of the color, defined numerically as the average of the equivalent red, green and blue (RGB) values. In HSV, definition of saturation is a measure of a color's purity/greyness. Purer colors have a saturation value closer to 1, while greyercolors have a saturation value closer. In particular, for each of the clothing image, the color detector classifies the pixels in the image to the following colors: white, black, red, orange, yellow, green, cyan, blue, purple, pink **,** and grey. Each image of an article of clothing is first converted from RGB to HSV color space. Then, HSV space is quantized into a small number of colors. If the clothe contain multiple colors, the dominant colors will be outputted. The dominant colors will be communicated in auditory to the blind user.

4.2 Clothing Pattern Recognition

4.2.1. Multiple Features
In order to deal with the large intraclass variations presented in the clothes pattern, global features and local structural features are concatenated.

4.2.2 .Classification
Concatenated feature vector is given as input to SVM(support vector machine) .The confidence margin is the measure of how close an instance is to the classification boundaries of classifier. It represents the reliability of prediction output based on a specific feature. In the context of classification, an instance close to the class boundary is less reliable than the one deep in the class territory. The support vector machine is used as classifier to classify the clothing patterns into four different categories (plain, plaid, stripe and patternless) in our clothes pattern recognition system.SVM finds a maximum margin hyperplane in the feature space.

4. Experimental Result

4.1 Dataset

CCNY clothing pattern dataset [9] is used for testingpurpose. It contains 624 images of four clothing pattern: plaid, striped, patternless and irregular.

4.2 Result Discussion

Performance in clothing pattern recognition with image features extraction method is evaluated and compared based on global and local features such as Bag-of-SURF,DWT+GLCM and combination of features. Out of 156 images of each category,56 images are used for training the classifier and remaining 100 images are used for testing.Table I shows calculated clothing pattern error rate of clothing pattern recognition (%).

Table 1: Recognition error rate (%) of different methods on clothing pattern dataset

Method	Error Rate(%)
SURF	25.25
DWT+GLCM	47.34
SURF+DWT+GLCM	23.75

5. Conclusion

The proposed clothing patterns and colors recognition system would help visually impaired people in their daily life. Color detection is based on normalized color in HSV color space and is able to detect multiple colors including red, black, orange, yellow, green, grey, cyan, blue, purple, pink, and white. A method to classify clothes patterns into 4 categories: striped, checks, plain and patternless are proposed here. The method provides new functions to improve the life quality for blind.

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Author Profile

Manisha Dhongade is pursuing M.E. in Computer Engineering from Pune Institute of Computer Technology. She received the B.E. degrees in Computer Engineering in 2010.