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CLOTHING PATTERN RECOGNITION BASED ON LOCAL AND GLOBAL FEATURES

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Abstract— Choosing clothes with appropriate color and pattern is very challenging for amaurotic people. Amaurotic people are those who have partial sight due to medical reasons or lost their sight in an injury. Although, there are some automatic system for identifying clothes and patterns, still it is challenging by reason of large intraclass pattern variation. To accord with such obstacles, a Computerized Clothing pattern and Color Recognition system is introduced. The proposed system consists of 3 components a camera, data analysis unit and speaker. The camera captures the user's cloth, data analysis unit will identify the complex pattern and finally the results are described to amaurotic people verbally. This system is capable of recognizing 4 major patterns (plaid, striped, irregular and patternless) and 11 colors. The system is proficient of analyzing both local and global features of the pattern. Radon signature detects the principal orientation of the image and to distillate global features of clothing patterns, Statistical properties from wavelet subbands are used. Finally to extract local features, SIFT detectors are used. Both local and global features are integrated to recognize complex clothing patterns. Clothing color identification is done using HSI color space. This system is found to be active and simple for amaurotic people.

Keywords— Amaurotic people, local and global features, intraclass pattern, principal orientation.

1. INTRODUCTION

There are almost 25,000 blind and partially sighted children in India. The number of people in the India with sight loss is set to increase dramatically. It is predicted that in the year 2050 the number of people with sight loss in the India will double to nearly 4000000. Amaurotic people suffer rom partial or total loss of sight, especially in the absence of a gross lesion or injury but not blind from the birth. They suffer from problems such as Age-related macular degeneration, reading the printed labels, security issues, identification of food pattern, way finding-the ability of a person to find his or her way to a given destination and etc[2][3][4].

Color plays a vital role in day to day life of a normally sighted people. Normally sighted people use as the basis of number of everyday tasks such as matching socks, choosing between different clothes and etc. Choosing clothes with suitable colors and patterns is a challenging for amaurotic people. They manage this task with the help from family members, using plastic brakkine labels.

To overcome such problems an automatic or computerized cloth pattern recognition system for amaurotic people as been designed. This is an energetic task due to many clothing pattern and color designs as well as corresponding large intraclass variations. Existing approaches mainly focus on textures with large changes in view point, orientation, and scaling but less intraclass pattern and intensity variations.

In the proposed system, a camera-based system analysis method is used to help amaurotic people for recognizing clothing patterns and colors. The system contains the following major components(Fig 1) 1) a camera for capturing clothing images, a micro phone for speech command input and speakers (or Bluetooth, earphone) for audio output; 2) data capture and analysis unit to perform command control, clothing pattern recognition, and color identification by using a computer which can be a desktop in a user's bedroom or a wearable computer (e.g., a mini-computer or a smart phone); and 3) audio outputs system to provide recognition results of clothing patterns and colors, as well as system status.

This camera based system can handle clothes with complex pattern and recognize clothes into four categories (plaid, stripped, patternless, and irregular) and identify 11 colors: red, orange, yellow, green, cyan, blue, purple, pink, black, grey and white. To handle large intraclass variations, a novel descriptor Radon Signature is used to capture the global directionality of cloth patterns. The local features are identified using Scale Invariant Feature Transform (SIFT descriptors).The combination of global and local image features significantly outperforms the clothing pattern by using Support Vector Machine (SVM) classifier. The recognition of clothing color is implemented by quantizing clothing color in the HSI (hue, saturation, and intensity) space. Finally, the recognition results of both the clothing patterns and colors are given to the user.

This paper is organized as follows: Section 2 gives the summary of existing systems. Section 3, describes the proposed work. In Section 4, information about dataset and in Section 5, experimental results are shown. Finally, Section 6 concludes the paper.

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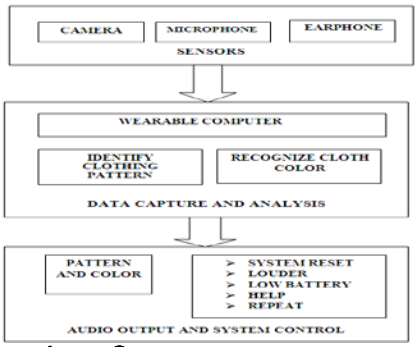

FIG 1: OVERVIEW OF PROPOSED ARCHITECTURE

2. RELATED WORK

Efficient systems are being developed to improve the life quality and safety of amaurotic people. The systems such as banknote recognition, way finding, display reading etc., [2],[3],[4] plays important role in their day-to-day activities. The another main area where a color blind person faces a problem is that, selecting clothes of desired colors and patterns without the help of the another person[5][6][7].

Xiaodong Yang [5], proposed a Confidence Margin Based Feature Combination, to select cloth and color for blind people. The system employed Radon signature to capture global directionality features and was found to be 92.55% efficient , structural information of texture are employed by using SIFT . On the other hand, it was observed that the combination of multiple complementary features usually achieves better results than the most discriminative individual feature.

Dhongade M [6], proposed a new method that captures Global features from image using DWT+GLCM (Gray Level co-occurrence matrix) and it is combined with SURF local features. The concatenated vector is given as an input to SVM (Support Vector Machine). Even though GLCM+DWT improve accuracy, the complexity is high and its time consuming process.

Tian [7], proposed a new method to match clothes from pair of clothing images. Texture analysis is done by using Radon transform, wavelet features and co-occurrence matrix to handle illumination changes and rotations. Radon transform is employed for estimating the orientation of texture patterns and Histogram equalization is performed to decrease illumination changes. For each wavelet sub images, co-occurrence matrix for gray texture analysis is calculated. Finally, the texture matching is performed based on statistical classification included six features e.g. mean, variance, smoothness, energy, homogeneity, and entropy. However, this system is not able to automatically recognize clothing patterns.

In all these works [2][3][4][5][6][7], the needs of blind people are considered. Existing system [5][6][7] focus on clothing pattern which possess large change in viewpoint, orientation and scaling , but less with intraclass and intensity variations. The proposed system has been designed to identify cloth pattern where the intraclass and intensity variations are more.

3. PROPOSED WORK

The proposed work is for developing an assistive system which automatically recognizes the color and cloth pattern for amaurotic people. A portable camera can be mounted upon a pair of glass to capture the cloth pattern. These images are applied through the input of wearable computer. Data analysis unit identifies the color and pattern of the cloth. Finally, a speech based audio output provides the color and pattern of the cloth.

The proposed system consists of two major divisions. They are (1) Texture Recognition (2) color Recognition. The work flow of the proposed system is shown in Fig 2.

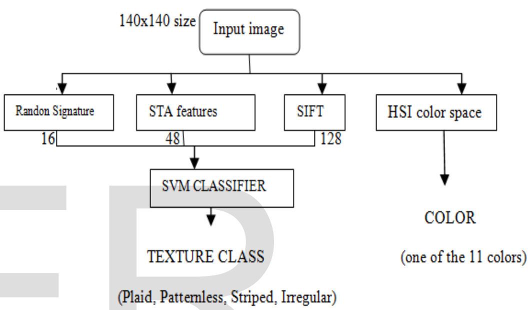

FIG 2: WORK FLOW OF PROPOSED SYSTEM

3.1 TEXTURE RECOGNITION

In general, to identify the cloth pattern both the local and global features are extracted from the input image.

3.1.1 Radon Signature:

Radon Signature is to characterize the directionality feature of clothing patterns. Radon Signature (RadonSig) is based on the Radon transform which is commonly used to detect the principal orientation of an image. The Radon transform of a 2-D function f (i, j) is defined a

$$R(r,\theta) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} f(i,j)\delta(r - i\cos\theta - j\sin\theta)\,di\,dj \qquad (1)$$

Where r is the perpendicular distance of a projection line to the origin and θ is the angle of the projection line. The input image (Fig 3) is then rotated according to this dominant direction to achieve rotation invariance.

To retain the consistency of Radon transform for different projection orientations (Fig 4), it is done based on the maximum disk area instead of the entire image.

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The large intra class variations of clothing patterns also reflect as images in the same category present large changes of color or intensity.

FIG 3: INPUT IMAGE (PLAID)

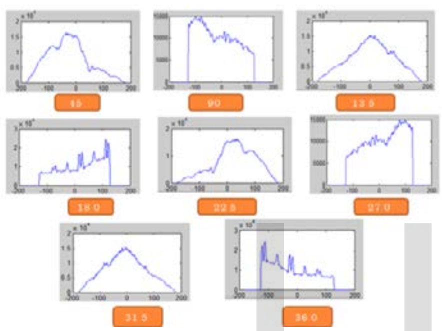

FIG 4: FEATURE VECTORS OF RADON SIGNATURE

3.1.2 Statistics of Wavelet Sub Bands

Statistical features are well adapted to analyze textures which lack background clutter and have uniform Statistical properties.DWT transforms the spatial domain pixels into frequency domain information that are represented in multiple sub-bands, representing different time scale and frequency points. Four statistical values including variance, energy, uniformity, and entropy to all wavelet sub bands are employed. Thus, the STA is a feature with the dimension of 48 (3 × 4 × 4). The four normalized statistical values extracted from each wavelet sub-band can be computed by the following equations (2-5):

$$\text{variance(vr)} = \sum_{i=0}^{L-1} \frac{(z_i - m)^2 p(z_i)}{(L-1)} \quad (2)$$

$$\text{energy(E)} = \sum_{i=0}^{L-1} (z_i - m)^3 p(z_i)/(L-1)^2 \quad (3)$$

$$\text{uniformity(sd)} = \sum_{i=0}^{L-1} p^2(z_i) \quad (4)$$

$$\text{Entropy (et)} = -\sum_{i=0}^{L-1} p(z_i)\log_2 p(z_i) \quad (5)$$

Where Z_i and p (Z_i), i = 0, 1, 2. . . L − 1 is the intensity level and corresponding histogram; L is the number of intensity levels; m $=\sum_{i=0}^{L-1} p(z_i) z_i$ is the average intensity level. Statistical values are extracted from the input image (refer FIG 3). The extracted values are given in Table I.

TABLE I EXTRACTED STATISTICAL VALUES

Features	Values
Variance (vr)	2423.57279511854
Energy (E)	1
Uniformity (sd)	49.2297958061837
Entropy (et)	1.3411329484789

3.1.3 Scale Invariant Feature Transform Bag of Word

One of the most general and frequently used algorithms for category recognition is the bag of Words. This Algorithm generates a histogram, which is the distribution of visual words found in the test image. The purpose of the Bow model is representation. Representation deals with feature detection and image representation. Features must be extracted from images in order to represent the images as histograms.

There are certain features or characteristics that can be extracted and define what the image is. Features are then detected and each image is represented in different patches. In order to represent these patches as numerical vectors we used SIFT descriptors to convert each patch into a 128-dimensional vector. SIFT is used for reliable recognition since it has the benefits such as the features extracted from the training image be detectable even under changes in image scale, noise and illumination. After converting each patch into numerical vectors, each image is a collection of128-dimensional vector. Detectors are used to detect interest points by searching local extrema in a scale space; descriptors are employed to compute the representations of interest points based on their associated support regions. We perform L2-norm and inverse document frequency (IDF) normalization of BOW histograms.

3.1.4 Support Vector Machine (SVM) Classifier

Support Vector Machine (SVM) is primarily a classifier method that performs classification tasks by constructing hyper planes in a multidimensional space that separates cases of different class labels.

SVM supports both regression and classification tasks and can handle multiple continuous and categorical variables.

In the proposed system, the extracted global and local features are combined to recognize clothing patterns by using a support vector machines (SVM s) classifier. It is to classify the clothing patterns into four different categories (plain, plaid, stripe and patternless) for pattern recognition system. SVM finds a maximum margin hyperplane in the feature space.

3.2 CLOTHING COLOR RECOGNITION

Clothing color identification is based on the normalized color histogram of each clothing image in the HSI color space. The key idea is to quantize color space based on the relationships between hue, saturation, and intensity. In particular, for each clothing image, our color identification method quantizes the pixels in the image to the following 11 colors: red, orange, yellow, green, cyan, blue, purple, pink, black, grey, and white. The detection of colors of white, black, and gray is based on the saturation value S and intensity value I. For other colors (i.e., red, orange, yellow, green, cyan, blue, purple, and pink), the hue values are employed. Clothing Colors are identified for the Input Image (refer FIG 3) and the corresponding color values are listed in Fig 5.

	%
black	77.9633
White	0
Gray	23.1033
red	4.1605e-04
yellow	0.4669
green	12.6297
cyan	9.5047
blue	4.6646
purple	0
pink	0
orange	0

Fig 5: Recognized colors for Input image

4. DATASET

CCNY Clothing pattern dataset includes 627 images of four different typical clothing pattern designs: plaid, striped, patternless, and irregular with 156, 157, 156, and 158 images in each category. The resolution of each image is down sampled to 140 × 140.The clothing patterns also demonstrate much larger intraclass pattern and color variations. The clothing pattern dataset can be downloaded via the research website (www.media-lab.engr.ccny.cuny.edu/data).

5. EXPERIMENTAL RESULTS

In this section, we evaluate the performance of proposed system using CCNY dataset. The final descriptors compared in recognition experiments include Radon signature, STA, SIFT, and Radon+ STA +SIFT. STA and SIFT are statistical descriptors and SIFT descriptors extracted from original images. The recognition experiments are evaluated by using 30%, 50%, and 70% of the dataset as training sets, and the rest as testing sets. The recognition results for different combinations of descriptors and training sets are demonstrated in Table II.

TABLE II

RECOGNITION ACCURACY UNDER DIFFERENT VOLUMES OF CLOTHING PATTERN DATASET

METHOD	30%	50%	70%
RADON	62.34%	65.38%	69.54%
STA	74.63%	76.81%	79.3%
RADON+STA	84.80%	87.09%	88.68%

As shown in table II, the combination of Radon+ STA yields better recognition result comparing to all other results. The recognition accuracy of Radon + STA using 70% of training images is better than training images of 30% and 50%.It is also observed that the accuracy obtained using 30% of training in our method is more better than other methods which has used using 70% as the training dataset. The performance of the proposed system will be further improved by the combination of RADON+STA+SIFT since both the local and global features are separately identified and the values are finally given to SVM classifier.

6. CONCLUSION AND FUTURE WORK

The proposed system is to recognize clothing patterns and colors for amaurotic people to improve their life quality. Global features are identified by using Radon Signature and STA. Local features are extracted by using SIFT (Scale Invariant Feature Transform) features. The Proposed system identifies 11 colors and 4 Patterns (plaid, striped, pattern less, and irregular).The simulation of the proposed system is done using CCNY dataset in MATLAB environment. In future, Pattern recognition system will be enhanced by adding more colors and patterns.

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