NOVATEUR PUBLICATIONS
International Journal of Research Publications in Engineering and Technology [IJRPET]
ISSN: 2454-7875
VOLUME 3, ISSUE 7, July-2017

CLOTHING PATTERN RECOGNITION FOR VISUALLY IMPAIRED PEOPLE

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ABSTRACT:

It is very difficult for visually impaired people to choose clothes with different patterns and colors. Pattern Recognition method can be implemented to carry out automatic cloth pattern recognition with machine learning approach. For researchers, automatic clothing pattern recognition as a challenging research problem due to the factors of large intra class pattern variations, scaling, illumination and rotation. The system proposed here considers a PC based system that can be used to recognize the clothing patterns in four different categories (stripped, plaid, irregular and pattern less) and also identify color in terms of percentage of 15 basic colors. It is implemented using MATLAB tools for image processes. A database of cloth images present in wardrobe of a visually impaired person is prepared. Features of the test image can be extracted using special functioned descriptors. After identifying the features, nearest neighbor method classifies the images in order to their categories. By normalizing the histogram of image in HIS color space, colors in the image are identified. The pattern and color identification result is given as audio output.

KEYWORDS: clothing pattern recognition, radon signature; visually impaired people; HSI color space; sobel operator; histogram.

I. INTRODUCTION:

Visually impaired people feel helpless when it comes to choosing cloths with different patterns and colors. They usually manage it taking help from others. Some may go for special braille labels made of plastic or use various stitching tags on the cloths. Due to these much of difficulties some finds it easy to wear uniform type of cloths every day without any pattern. Automatic system to recognize the cloth patterns and colors may make their life considerably easier.

Various attempts have made to make visually impaired peoples life easy in many ways [5], [9], [16], [20], [21], [22]. Camera based automatic cloth pattern recognition systems is difficult to practically implement due to large number of patterns and colors in cloths and corresponding large intra class variations [7]. There are few existing texture analysis methodologies which mainly concentrate on textures having large changes in viewpoint, scaling and orientation but with less intra class pattern and intensity variations (see Fig.1). Even though many image processing and computer vision techniques have been developed, it is being witnessed that traditional texture analysis methods [6], [11], [12], [15], [19], [23], [24] cannot reach the same level of accuracy in terms of cloth pattern recognition.

Here, we are considering the image which is assumed to be captured by a steady fixed camera with cloth placed in front of it. Due to this kind of arrangement we can expect more accurate results as there would be uniform plane with uniform rotation. A desktop PC or laptop is considered for data capture and analysis so as to achieve command control, cloth pattern recognition and color identification. An audio output can be generated after completing the analysis. For the scope of actual implementation, only image analysis for clothing pattern and color detection using MATLAB tools is considered.

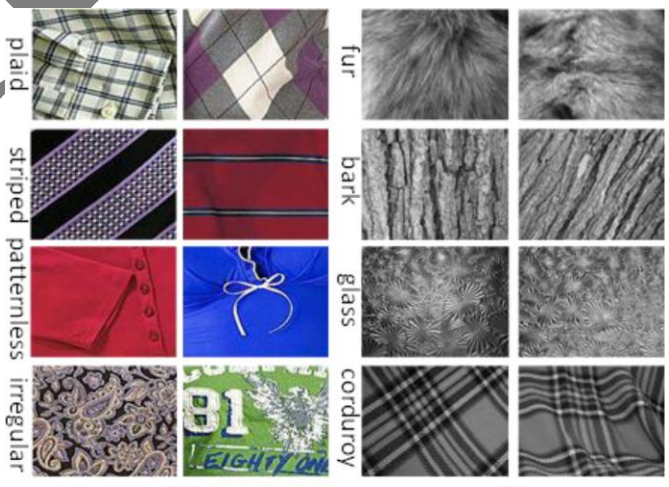

Fig. 1. (a)Clothing pattern example with large intra class color and pattern variations. (b)Traditional texture examples with less intra class intensity and pattern variations.

The system is capable of identifying four patterns namely Plaid, Striped, Pattern less and Irregular [1], [2], [3] to meet basic requirement of identification. In extension to [1], [2], [3] it is capable of identifying 15 colors: green, light

green, yellowish green, yellow, orange, blue, sky blue, pink, magenta, red, cyan, purple, gray, black and white.

This paper is planned as follows: In section-II, related work for this project is stated in brief. In Section-III, the block diagram or flow of the system is shown and explained. In Section-IV, the methodology of the system is explained. In Section-V, the implementation and result is elaborated in detail. In Section-VI, the conclusion of the system is given.

II. RELATED WORK:

Many systems have been developed for easy assistance to visually impaired people in their day to day life [1], [2], [3], [4], [5], [9], [21]. Traditionally, texture analysis techniques used to be very popular for cloth pattern guessing. But those fail when it comes to images with large intra class, intensity and color variations [6], [11], [12], [15], [19], [23], [24]; though they effectively able to detect large variations in image orientation, viewpoint and scaling.

To overcome this few researchers came up with new methods which can also detect large intra class variations [1], [2], [3]. They used Radon transform to detect global directionality; global statistical features were detected using STA on wavelet sub-bands and local features were identified using SIFT (Scale Invariant Feature Transform) and BOW (Bag of Words) histograms [1]. RQA (Recurrence Quantification Analysis) uses recurrence plot and recurrence rate to extract local features [2]. Using mathematical morphology, it is possible to implement topological operations to find local features [3]. Combining local and global features gives better results in terms of accuracy.

III. BLOCK DIAGRAM:

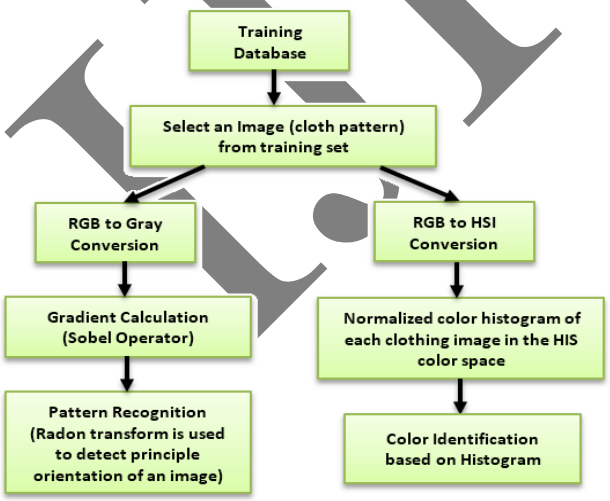

Fig. 2. Block diagram representation of methodology of clothing pattern and color recognition.

The block diagram basically shows the approach of the system to get required results. Training and testing datasets are build. From this dataset, the image is selected. Image is converted from RGB to Gray Scale. Using Sobel operator, the Gradient calculation is done. Radon signatures identify the principle orientation of the image. With the help of these, the features of the image are extracted and pattern recognition is done.

For color identification, RGB to HSI conversion is done. Histogram is used to decide the color contributions in image. Normalizing the histogram in HIS color space gives identification of colors in the image.

IV. METHODOLOGY:

Clothing patterns are categorized by repetition of few basic primitives. But due to large intra class variations, there is possibility of significant variation in local primitives of same cloth pattern category. Global features which includes statistical properties and directionality of clothing pattern are more stable inside the same category. So they are capable to give complementary information about local structural features which can be extracted using descriptors [17], [18]. Local and global Feature extraction is the crucial part of pattern recognition. These features can be take out using following algorithms

A. GRADIENT CALCULATION:

The image to be recognized is first converted from RGB to gray scale. This in turn eliminates hue and saturation from the image keeping luminance intact. Sobel operator is use to generate horizontal and vertical edge emphasizing filters. It forms a correlation kernel which is used to filter the image. Consider 'dx' and 'dy' be horizontal and vertical filtered multidimensional arrays of the image. Then the magnitude of Gradient can be calculated as,

$$Gmag = \sqrt{dx^2 + dy^2} \quad (1)$$

This again multiplied with the mask of particular size and shape to get final Gradient magnitude. Mask is used to consider particular area of image under consideration.

B. RADON SIGNATURE

Major challenge for cloth pattern recognition is, clothing images consists of large intra class variations. Also, in a broad view, the directionality of cloth patterns is more reliable across various categories and can be used as a significant property to identify various cloth patterns. The cloth patterns of irregular and pattern less are both isotropic. However, the cloth patterns striped and plaid are anisotropic. Directionality feature of clothing patterns are characterized by a new descriptor, i.e., the Radon Signature so as to make this difference of directionality useful (see Fig. 3).

Radon Sig (Radon Signature) senses principle orientation of an image [10]. It is based on Radon

transform. To get rotation invariance, the image then can be rotated with respect to this dominant direction, Projection line and angle of projection 'theta' plays important role during Radon transform.

C. STATISTICAL (STA) FEATURE EXTRACTION

Statistical features are well improved to analyze textures [8] which have uniform statistical properties and lack background clutter. Wavelet transform is used to carry out statistical feature extraction and it decomposes image pixel into low pixels. To classify image, STA uses variance as a key feature. It is expected to calculate the distinct energy value on each sub-band.

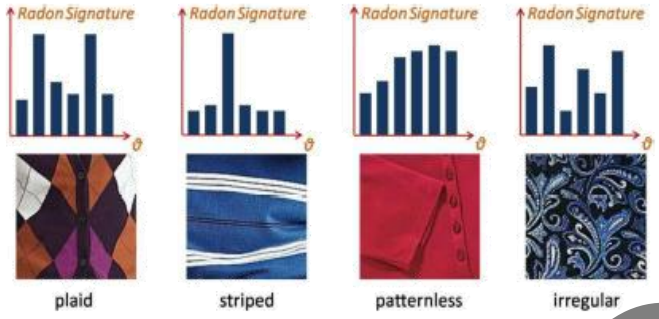

Fig. 3. Pattern and its Radon Signature.

Clothing image is exposed to three levels of wavelet decompositions. Each level of decomposition consists of four wavelet sub-bands of horizontal, vertical, original and diagonal components which are arranged from the close to the distant in each level. The statistical values obtained in every wavelet sub-band is used to form the final descriptor (see Fig.4).

The extracted features are compared and using nearest neighbor method [13], [14], image is classified is four categories: stripped, plaid, irregular and pattern less.

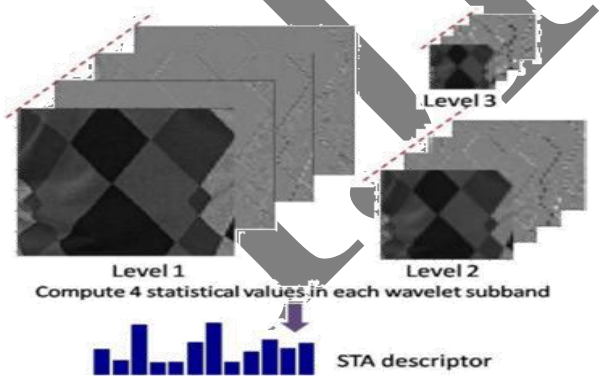

Fig. 4. The calculation of STA on Wavelet sub-bands.

D. NORMALIZING OF HISTOGRAM IN HSI COLOR SPACE:

For color identification the image is first converted from RGB to HSI color space. Histogram of the image in terms of hue is formed. Fifteen color vector is created to represent fifteen colors. Using hue values, color vectors for green, light green, yellowish green, yellow, orange, blue, sky blue, pink, magenta, red, cyan and purple are prepared. Saturation and intensity values are used to form color vectors of gray, black and white. When saturation is less than its threshold value, if intensity is larger than its upper threshold, the color is white. If intensity of pixel is less than its lower threshold, then color is black. For any intensity value between upper and lower threshold, the color is gray. All these color vectors are then normalized to get color values in terms of percentage.

V. IMPLEMENTATION AND RESULT:

The implementation of cloth pattern recognition and color identification is being carried out using MATLAB. More focus of project work is towards developing the algorithms which gives accurate results to maximum possible.

A. DATASETS:

Here, we have prepared two datasets of images as: (a) Training dataset and (b) Testing dataset. Training dataset consist of 627 sample data images which are used as database for kind of four patterns we are taking under consideration as follows: plaid (157), striped (158), pattern less (156) and irregular (156). The resolution of each image is restricted to 140 X 140. The testing datasets are to be assumed captured images from some camera-based system.

B. EXPERIMENTAL SETUP

Graphical user interface screen [4] is developed in MATLAB where we can import images from testing datasets and initiate the process of pattern and color identification (see Fig.5).

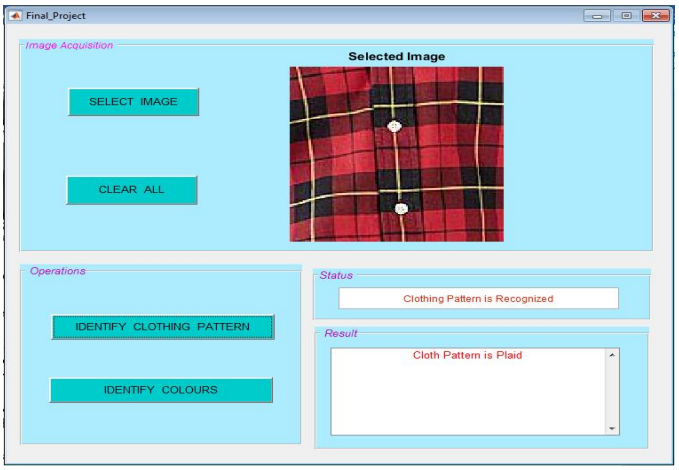

Fig. 5 MATLAB User interface

Also result of color identification is represented in graphical view (see Fig.6). After processing MATLAB gives directly audio output as it is necessary with visually impaired or blind people.

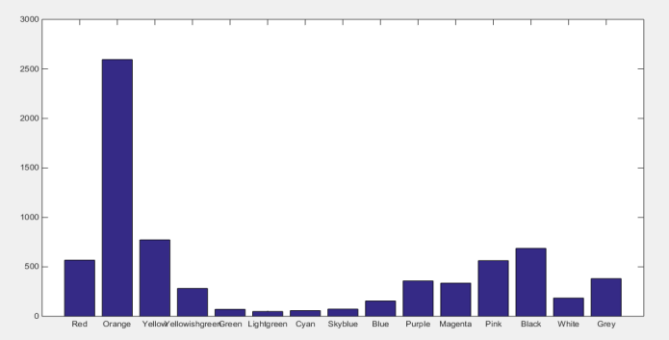

Fig. 6 Color identification graphical result

C. PATTERN RECOGNITION:

Pre-processing is done by Radon transformation. Radon transforms gives directionality of the image in two types as: isotropic and anisotropic. Pattern less images have smooth principle orientations, plaid have two principle orientations and stripped have one principle orientation. Principle orientations are not specific for irregular pattern (see Fig.3).

Using Radon transformation and Gradient magnitude, variance feature of the image is extracted. This extracted feature is classified into four types (stripped, plaid, irregular and pattern less) using nearest neighbor method. Rather than using individual features for pattern matching, a combination of multiple features may give better results. However, in terms of class distribution; performance may downgrade due to contradictory, noisy and overlapping features.

D. COLOR IDENTIFICATION:

Cloth color identification is carried out by normalized histogram of color of each cloth image in to the HSI color space. HIS stands for hue, intensity and saturation. As per the concept, color space is quantized which is depending on the relations between hue, saturation, and intensity. Pixels in the image for each image are quantized by the system into 15 distinct colors as follows: white, grey, black, pink, magenta, purple, cyan, sky blue, blue, orange, yellow, yellowish green, green, light green and red. In case of cloth image having two or more than two colors, the dominant colors (the one having pixels larger than 5% in the whole image) will be used as output.

TABLE I. SAMPLE IMAGES WITH PATTERN AND COLOR RESULTS

Image				
Pattern	plaid	striped	patternless	irregular
Color	yellow(49%) orange(36%) black(9%)	blue(75%) white(19%)	red(98%)	black(41%) red(26%) blue(6%) green(5%)

The cloth patterns along with the colors jointly provide corresponding data. The pattern recognized provides extra information about how various colors are organized. For example, cloths with strips of red and purple color.

VI. CONCLUSION:

Here, we have suggested a system which could be an easy way out to visually impaired people or blind people in terms of selecting different cloths with different patterns and colors. Radon Sig gives the global directionality features. Using MATLAB R2014b with its standard image processing toolbox, we can identify patterns in following four types: plaid, stripped, pattern less and irregular. Also, 15 colors can be identified in terms of percentage composition. Both pattern and color information is possible to give in audio output through MATLAB itself. Due to the use of machine learning approach, more the training dataset, more precise results will be achieved.

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