International Journal of Scientific Research in Computer Science and Engineering
Vol.7, Issue.2, pp.1-6, April (2019)
DOI: https://doi.org/10.26438/ijsrcse/v7i2.16

Research Paper

E-ISSN: 2320-7639

Flower Classification using Different Color Channel

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Available online at: www.isroset.org
Received: 09/Mar/2019, Accepted: 14/Apr/2019, Online: 30/Apr/2019

***Abstract*—** In this paper, flowers are classified based on color and texture features where features are extracted from different color channel. Database have been used for experiments is Oxford flower 17 category. There are numbers of steps to get the final classification system. The pre-processing techniques like background elimination, noise removal and segmentation are applied on an original color images. From segmented color image R, G and B color channel is obtained if we use the RGB color model. GLCM (Gray Level Co-occurrence Matrix) method and LBP (Local Binary Pattern) methods are used for texture features extraction from the segmented color image. Color moment is used for color features extraction. A well-known classifier like SVM (Support Vector Machine) and NN (Neural Network) are used for classification. This paper contains comparison of classification results, as which classifier is more accurate for flower classification.

***Keywords*—** Classification, GLCM, LBP, Color moment, SVM, Neural network

I. INTRODUCTION

Digital Image processing have a significant role to draw out useful information from different images. Image processing systems can be used in various task like clustering, classification, object detection from an images or videos and character or pattern recognition. Image processing system contains number of steps applied on an image to enhance the quality of images or improve the imperfections of an images [4]. Because of large intra-class variation present and small inter class variation present among different classes, it is difficult to create system for classification [3]. The dataset contains the images of flowers which are taken in open air atmosphere where the illumination of lights changes with the time and weather [3]. Flower classification is an interesting and challenging problem to classify the flower species from its visual appearance. If anyone wants to do flower classification flower images taken from internet or through digital camera or smart phone [2] can be given as input into the flower classification system and it is classified by the system.

Flower classification has various applications like floriculture industry. The floriculture industry consist of flower trade means selling and buying flowers, nursery and potted plants, bulb and seed production, extraction of essential oil from flowers and micro propagation. All these activities are labor dependent, and all are done manually [1] [3]. In above cases, flower classification automation is necessary [1]. The other application of classification of flower is digital library, search engine which queries images based on text or keywords, gardening, Ayurvadic treatment and CBIR (Content-based image retrieval).

This paper, flower classification system, is developed using the features like texture (GLCM and LBP) [1] [3] and color (color moment) [2] features and for classification purpose neural network [1] [4] [14] and SVM [5] [9] [10] [15] classifier is used.

As we see the organization of paper then, Section I contains the introduction of flower classification system, Section II contain the related work of flower classification system, as many authors had done research on flower classification, Section III contain the methodology used in the system, as many methods are applied to find out the different features from the image, Section IV describes results and discussion.

II. RELATED WORK

Dr.S.M.Mukane and Ms.J.A.Kendule [1] they discussed about the classification of flower based on texture feature. The method used for feature extraction is DWT (Discrete Wavelet Transform) and GLCM (Gray Level Co-occurrence Matrix). ANN (Artificial Neural Network) is used for classification of flower. But they used only 10 images from each class hence total 50 images for classification, Very less

dataset is used. Basavanna M and S. S. Gornale [2] they proposed Identification and Classification of Flowers Images using Color models. They used edge and color characteristics for classification. The featured like edge, red, green, blue, hue and saturation characteristics are derived from histogram. D S Guru, Y. H. Sharath and S. Manjunath [3] they discussed about the automatic classification of flower images using K-nearest neighbor classifier. The images are segmented using threshold based segmentation algorithm. Then, the texture feature are extracted from an images using Gray Level Co-occurrence Matrix (GLCM), Gabor or combination of both. Classification is performed using k-nearest neighbor classifier. Cheng-Yu Huang, Yen-Liang Lin and Winston H. Hsu [5] they expands the training data from web for recognition of flower. First they resize the images to same width and detect their salient region then use GrabCut to extract foreground region based on salient values. Shape and color feature are extracted from the gray-scale image and color image using SURF feature and opponent SURF feature respectively. Support Vector Machine (SVM) classifier is used for classification. Maria-Elena Nilsback and Andrew Zisserman [6] explored the concept of a visual vocabulary for flower classification. Segmentation applied for all image is contrast dependent prior MRF (Markov random field) cost function optimizes using graph cuts. Then create vocabulary to represent the color of a flower. Color of a flower is described using HSV color space. For the training images, k-means clustering is used to cluster the HSV values for each pixel. For classification, nearest neighbor classifier is used. T. Tiay, P. Benyaphaichit and P. Riyamongkol, [7] explored the concept of the recognition of flower. For classification of flowers, color and edge characteristics of flower images are used. Histogram is used to derive the color characteristics and edge characteristics are acquired through Hu's seven moment algorithm. For classification they take K-nearest neighbor. The accuracy of the system is more than 80%. But the problem is that similar color flower and similar shape flower has less accuracy.Soon-Won Hong and Lynn Choi [8] described an approach focused on automatic flower recognition using edge and color based contour detection. In pre-processing, the system performs morphological transformation and smoothing for noise removal from an image. Then edge based contour and color based contour is detected, edge based contour is detected using first derivative, Sobel differential operation is used. Then to classify its color groups, K-means clustering is used. And for contour shapes, history matching is used. Anelia Angelova, Shenghuo Zhu and Yuanqing Lin [9] discussed about flower recognition for large-scale subcategory. They briefly described image segmentation algorithm. Laplacian operator is used for segmentation. Support Vector Machine (SVM) is used for classification.

III. METHODOLOGY

A. *Overview of the system*

Fig. 1 shows the flow of the flower classification system.

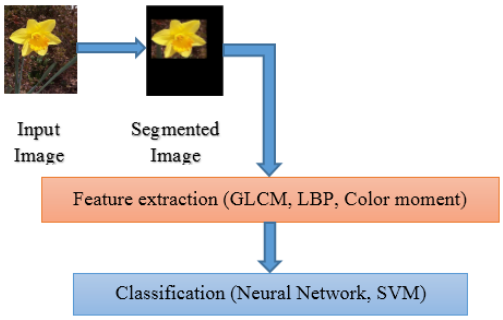

Fig. 1. Block diagram

Oxford 17 category flower dataset is used for classification. Pre-processing and segmentation techniques are applied on the input images taken from the dataset to make the images for further processing. Then GLCM and LBP methods are applied on the different channel of an images for texture feature extraction and color moment is applied for color component. Classification is done using NN and SVM classifier and we get the classification accuracy. And compare the results of both classifier.

The input images are given to the system. For image segmentation, firstly, convert the color image into grayscale image. Then Binary image is obtained from grayscale image using threshold. Where, threshold is determined using Otsu's method. Binary image have white foreground and black background. Create the bounding box around the foreground in the binary image to get the color segmented image from the original image. From color segmented image, R, G and B different color channel is obtained for RGB color model.

B. *Feature extraction*

1) GLCM

Texture features using GLCM method is extracted from the grayscale image but we extract the texture features based on the color model. Hence features are extracted from different color channel. We use the RGB color model, hence extract R, G and B channel from the color segmented image. Texture feature extraction means measure the intensity variation in the image at interested pixel [1] [3] [4] [16]. Extraction of Co-occurrence texture features are done in two steps [1] [3] [4] [16]. First is, create a GLCM by using spatial co-occurrences of pixels in pair which is separated by a particular angle and distance [1] [3] [4] [16]. The GLCM is a square matrix of M × M, where M is the different gray levels present in an image [1] [3] [4] [16]. Second, created GLCM is used to calculate the different property of GLCM

like correlation, contrast, energy, local homogeneity, norm entropy, inverse difference moment, maximum probability, cluster prominence and cluster shade. Here we have used four properties contrast, correlation energy and homogeneity [1] [3] [4] [16]. We get the 8 features from the four properties. We have to extract the all four properties from the R, G and B channel. Hence total 24 features are obtained from GLCM method.

Formulas for feature extraction techniques are given below.

$$Contrast = \sum_{i,j} |i-j|^2 p(i,j) \quad (1)$$

$$Correlation = \sum_{i,j} \frac{(i-\mu i)(j-\mu j)p(i,j)}{\sigma_i \sigma_j} \quad (2)$$

$$Energy = \sum_{i,j} p(i,j)^2 \quad (3)$$

$$Homogeneity = \sum_{i,j} \frac{p(i,j)}{1+|i-j|} \quad (4)$$

2) Color moment

Color feature can be extracted using Color Moment [2]. Central moments uniquely describe a probability distribution in the same way that color moments are measures that characterize color distribution in an image [2]. Color moments are mainly used for color indexing purposes. In various application like image retrieval, to compare the two images as how both are similar in terms of color then color feature is used [2]. Color moments are rotation and scaling invariant. Color moments give information about shape and color [2]. When lighting conditions are changing then color is a good feature to use, but they cannot handle the situation very successfully when part of an image is block by another [2]. It is computed for any color model like RGB, HSV, and CMYK. In color model, per channel three color moments are computed. E.g. if color model is RGB [5] then 9 moments and if color model is CMYK then 12 moments are computed [2]. We have used RGB color model. Hence we get 9 features from the color moment.

a) Mean

The first color moment is mean, it can be explained as the average color in the image [2].

$$E_i = \sum_{j=1}^{N} \frac{1}{N} pij \quad (5)$$

Where p_{ij} denotes j^{th} pixel value at i^{th} color channel and N is the total pixels present in the image [2].

b) Standard Deviation

The second color moment is standard deviation, which can be calculated by taking the square root of the variance of the color distribution [2].

$$\sigma_i = \sqrt{\left(\frac{1}{N}\sum_{j=1}^{N}(pij - Ei)^2\right)} \quad (6)$$

Where E_i is the mean value for i^{th} color channel [2].

c) Skewness

The third color moment is skewness. It measures how much the color distribution is asymmetric, and hence it provides the shape of the color distribution information in an image [2].

$$S_i = \sqrt[3]{\left(\frac{1}{N}\sum_{j=1}^{N}(pij - Ei)^3\right)} \quad (7)$$

3) LBP

LBP works on grayscale images. But here we extract the texture features from the color model. We use RGB color model. Hence extract the R, G and B color channel from the color segmented image. In image, for every pixel in the image, the LBP value is calculated for the current pixel using the neighborhood pixel [10] [17]. The current pixel location in the LBP mask is replace by LBP value. LBP mask has same width and height as the input image. To find the LBP value for a current pixel, consider the 8 neighboring pixel around the current pixel. And compare the central pixel with the neighboring pixel. If the central pixel value is greater or equal to neighboring pixel value then the bit is set to 0 and if central pixel value is less than neighboring pixel value then the bit is set to 1. We get the binary array of 8 bit. Convert the binary number in to decimal number and store it at current pixel in the LBP mask. LBP Histogram is calculated from LBP mask and normalize the LBP histogram. And get the 256 features of the image. LBP is applied on R, G and B channel of the color image. We get total 768 features of the image.

From all three methods, the total feature vector length is 801.

4) PCA

Principal component analysis (PCA) is one of the statistical techniques frequently used in image processing and signal processing for the reduction of dimension of data [24]. This method provides a powerful tool for data analysis and pattern recognition. The PCA technique allows the identification of standards in data and their expression in such a way that it spot the differences and similarities of data. Once patterns are found, they can be reduce or compressed, i.e., their dimensions can be reduced without much loss of information [24].

C. Classification

For classification, two classifier are used. Neural Network (NN) [1] [4] [14] and Support Vector Machine (SVM). The input feature vector is created which is extracted using GLCM [1], LBP [10], and color moment. The input feature vector contains 24 GLCM values 768 LBP values and 9 Color moment values. This input vector is given to neural network for classification [1]. Neural Network (NN) is an information-processing paradigm that is inspired by the biological nervous systems, such as the brain, process information [1] [4] [14]. The algorithm used for training is back-propagation [1] [4] [14]. The output of the neural network is compared with the targeted output and error rate is calculated. And the error is given feed-back to the neural network to adjust the weights and to decrease the error rate [1].

SVM [5] [9] [10] [15] is one of the machine-learning algorithms. Assume that we have a set S of point's xi ∈ Rn where i = 1, 2, , N. Each point xi belongs to one of the two class yi and the label yi ∈ {-1, 1}. The goal is to create the equation of a hyper-plane that divides set S into two class having all the points belongs to class one on one side and the points belongs to class two on other side . SVM performs classification by constructing an N-dimensional hyper-plane that optimally separates the data into two categories.

IV. RESULTS AND DISCUSSION

The proposed system is tested for 10 classes (Daffodil, Snowdrop, lily Valley, Crocus, Tiger lily, Fritillary, Sunflower, Daisy, Buttercup, Windflower) and 80 images from each class hence total 800 images is used for classification . For neural network classifier, experiments are done using various combination of number of hidden layer and several of folds. In neural network, 7 fold means 70 % images is used for training and 30 % images for testing. Similarly for 8 fold and 9 fold. The results are shown in table I. For SVM also three different result based on the 70%, 80% and 90% training is shown in table I.

The table I shows the accuracy comparison of Neural Network and SVM classifier with different ratio of training and testing images with 801 features.

Table I. Accuracy comparison of classifier using 801 features

Classifier	7 fold	8 fold	9 fold	Average (%)
Neural network	82.20	84.12	85.87	84.06
SVM	89.08	90.12	91.37	90.19

By using 801 features, average accuracy of Neural Network classifier is 84.06 % and SVM is 90.19 %.

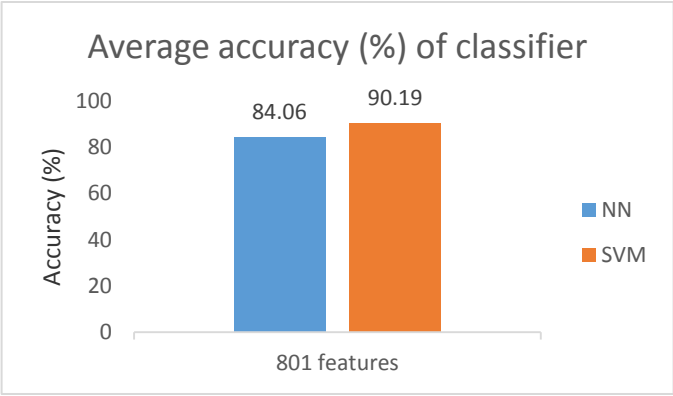

Fig.2

A. *Comparison of color image features with grayscale image*

If GLCM is applied on grayscale image then we get 8 features from an image. For color moment, this features are extracted from the different channels hence we get 9 features. For LBP method, if it is applied on grayscale image then we get 256 features by normalizing the histogram. Hence total features vector length is 284.

Table II. Accuracy comparison of classifier using 284 features

Classifier	7 fold	8 fold	9 fold	Average (%)
Neural network	60.04	61.37	65.37	62.26
SVM	61.91	64.43	65.12	63.82

By using 284 features, average accuracy of Neural Network classifier is 62.26 % and SVM is 63.82 %.

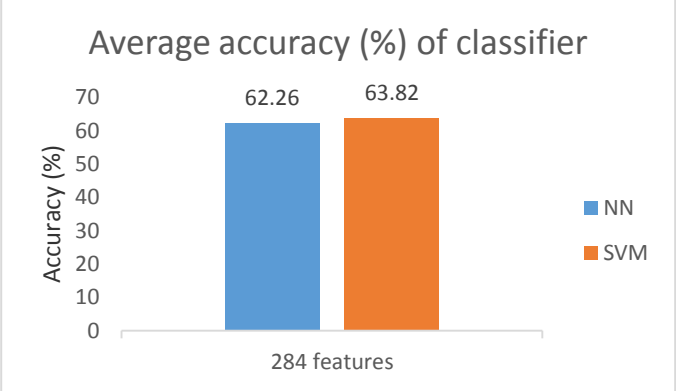

Fig.3

B. *Comparison of 284 features from grayscale image with the 284 features after applying PCA on 801 features of color image*

Features are extracted using GLCM, LBP and color moment. We applied the methods on R, G, B channel of color image hence we got 801 features from color image. By applying PCA on 801 features, we reduce the image feature vector to size 284.

Table III. Accuracy comparison of classifier using 284 features after applying PCA on 801 features

Classifier	7 fold	8 fold	9 fold	Average (%)
Neural network	70.37	74.25	79.75	74.79
SVM	87.20	87.68	91.00	88.62

By using 284 features after applying PCA, average accuracy of Neural Network classifier is 74.79 % and SVM is 88.62 %.

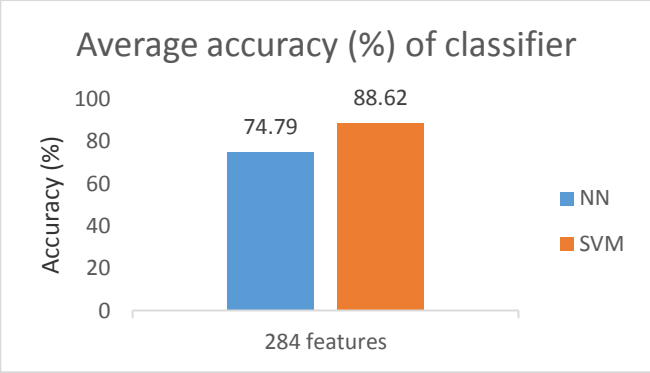

Fig.4

V. CONCLUSION

The flower classification system is completed by extracting texture and color features, using two classifier, neural network and SVM. The flower image is given as input which is taken from dataset. To acquire flower part in the image which is foreground, threshold is used for segmentation. Texture features are extracted using GLCM and LBP. And color features are extracted using color moment. We got 62.26 % and 63.82 % accuracy with 284 features using neural network and SVM classifier respectively. It is found that, feature extraction techniques applied on R, G, B channel give higher classification accuracy. We got 84.06 % and 90.19 % accuracy with 801 features using neural network and SVM classifier respectively. After applying PCA on 801 features to get the 284 standard features in data we got the 74.79 % and 88.62 % accuracy using neural network and SVM classifier respectively. Hence, we conclude that if we extract the feature from the grayscale image then we got the less accuracy in classification because in grayscale image, color components are diminished. 284 features got from the color image after applying PCA on 801 features also has higher classification accuracy than 284 features got from grayscale image because PCA can reduced the dimension without much loss of information. From the all above results, we can say that, SVM classifier is more effective then neural network classifier.

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