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Research paper

Various approaches of color feature extraction in leaf diseases under image processing: a survey

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Abstract

The detection of plant leaf disease is one of the major challenging tasks to prevent serious outbreak in the field of agriculture. Feature Extraction is one of the important techniques in digital image processing for simplifying the amount of resources required to explain a bulk set of data accurately. In image processing, image features normally include color, shape and texture features. Some researches made combina-tion of color and texture features used to recognize and classify leaf diseases. Mostly color is a widely used features obtained by different methods in feature extraction and respectively used to distinguish diseases in leaf. One of the difficulty in feature extraction based on color consumes more time to identify or classify the diseased part is the tricky one. The diseased leaf not exactly identified from its characteristics so the color feature extraction technique is used to identify the optimum that could differentiate between the target object and background of the leaves. Various color model combinations has been followed earlier for extracting the diseased spot from the leaf is discussed here. This paper also explains the performance comparison of different existing color based feature extractions.

Keywords: *Color Feature Extraction; Color Models; Feature Extraction; Leaf Images.*

1. Introduction

Feature extraction is a method of capturing visual content in an image and it is a special form of dimensionality reduction. Transforming the input data into the set of features is called feature extraction. The methodologies in feature extraction analyze objects and images to extract the most important features in various classes of objects. The objective of feature extraction is to reduce the original data by measuring certain features that differentiate one input pattern from another pattern. Normally different types of feature extraction exist they are Color feature extraction, shape feature extraction, intensity feature extraction and texture feature extraction [1]. Detecting the leaves diseased spot automatically is becoming a challenging task in many of image processing applications. Normally leaf color is used as guide for the assessment of plant health. Most of the existing researches proposed using RGB (Red, Green and Blue) color model to monitor the plant health in agriculture [2]. It is clear that some approaches are found inaccurate because the input image contains noise. The leaf features are two categories, they are visual feature and geometric. Geometric features can be defined as physically touched by human beings and manually measure using common tools such as ruler. Visual feature can be measured by using a computer method and it is not tangible. Color feature is a combination of different variances like RGB (Red, Green and Blue) [3]. Color is one of the most important features of an image and it is defined as a particular color space or model. A number of color spaces have been used in different researches such as RGB, LUV, HSI, YCbCr, HSV and HMMD. Once the color space is identified, color feature can be extracted from the images or regions. Likewise number of color features have been proposed namely color histogram, color moments, and color coherence vector and color correlogram and so on. Among all these features the color moments is one of the simplest effective features [4]. The common moments are mean, standard deviation and skewness can be defined as follows:

$$\mu_i = \frac{1}{N}\sum_{j=1}^{N} f_{ij} \quad (1)$$

$$\sigma_i = \left(\frac{1}{N}\sum_{j=1}^{N}(f_{ij} - \mu_i)^2\right)^{1/2} \quad (2)$$

$$\gamma_i = \left(\frac{1}{N}\sum_{j=1}^{N}(f_{ij} - \mu_i)^3\right)^{\frac{1}{3}} \quad (3)$$

Where f_{ij} is the color value of the ith color component of the jth image pixel and N is the total number of pixels in the image.
μ_i, σ_i, γ_i (i=1, 2, 3) denote the mean, standard deviation and skewness of each channel of an image respectively.
Color models: A color image is a combination of some basic colors. In MATLAB breaks each individual pixel of a color image termed as 'true color' down into RGB values. Nowadays images normally captured by using color equipments like digital cameras, mobile phones, video devices and other hand held devices. By capturing the photos with the help of these equipments the captured image may be in clear format, sometimes the taken images covered with noises. So it may be like colored images, low resolution images, web based colored images, graphical colored images or other format of images. To extract the color features from the content of a leaf image, a suitable color space followed with its descriptor. The main objective of color space is to facilitate the specification of colors. Various color spaces available in digital image processing such as RGB, HSI, HSV, CIE L*a*b, CIE L*u*v, have been developed

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for attain goal. Therefore, the RGB color space, a widely used system for representing color images and most commonly used method to represent color feature of an image is the color histogram [5].
RGB Color model: RGB color are specified the basic three primary colors such as Red, Green and Blue. A normalized color histogram is used to detect the pixels of leaf color of an image in RGB color space. It is the basic color model and other color models are derived from it and it is light sensitive [6]. This color model is widely used color space for processing and storing digital images. Spectral mechanisms of these colors join additively to produce a final color. RGB color space is widely used throughout computer graphics and it represented by a three dimensional, Cartesian coordinate system as follows.

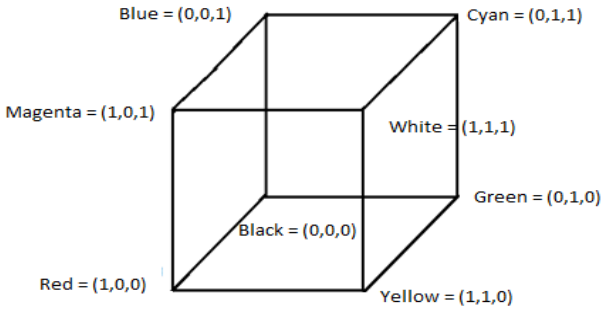


Fig. 1: RGB Color Mode.

Black is at the origin and white is at the opposite end of the cube. The gray scale follows the line from black to white. In a 24-bit color graphics system with 8 bits per color channel, red is (255,0,0) and on the color cube it is (1,0,0) [7].
YCbCr Color model: This specified in terms of lumninance (Y channel) and chrominance (Cb and Cr channels). It divides the image into a luminous component and chrominance components. The distribution of the leaf areas is consistent across different in Cb and Cr color spaces. Cb is difference between blue and luma component and Cr is the difference between red and luma component.

$$Y = 0.299R + 0.587G + 0.114B$$

$$Cr = R-Y,\ Cb = B-Y$$

In contrast to RGB, the YCbCr color space is luminance independent and it gives better performance [8]. YCbCr color space is used for component digital video is a scaled and offset version of the YUV color space. This color model is the basic color model used in analogue color TV broadcasting. The principal advantage of the YUV model in image processing is decoupling of luminance and color information. To convert the RGB image into YCbCr components, divide the chroma component Cb and Cr. The Y is define to have range from 16-235, Cb and Cr are defined to have a nominal range from 16-240 [9].
HSV Color model: HSV color is specified in terms of Hue (H), Saturation (S) and Value (V) are three components. This color model is widely used to describe color perceived by human being and the intensity value is represented by V. The transformation of RGB color model to HSV color model can be derived by the following with ranges of (0, 1) [10].

$$r = R / (R+G+B)$$

$$g = G / (R+G+ B)$$

$$b = B / (R+G+B)$$

Let MAX = maximum of (r, g, b) values and

MIN = minimum of those values then,

$$R' = \frac{MAX - r}{MAX - MIN}$$

$$G' = \frac{MAX - g}{MAX - MIN}$$

$$B' = \frac{MAX - b}{MAX - MIN}$$

$$S = \frac{MAX - MIN}{MAX}$$

$$V = MAX$$

Hue refers to the color of red, blue and yellow and has the range of 0 to 360. Saturation refers purity of the color and takes the value from 0 to 100%. Value refers the brightness of the color and provides the achromatic idea of the color [11]. So the hue (H), saturation or color purity (S), and the brightness (V) spaces are very useful and extended in many applications of image analysis and computer graphics [12].
HSI color model: This color model is an attractive color model for image processing applications because it represents color similarity that how the human eyes sense colors. In this model I is the intensity component, S is the saturation component that is the degree of white color embedded in specific color and H is the hue component that measures color purity. The HSI family of color models uses cylindrical coordinates for the representation of RGB points. This color model also known as HSL, where L represents the lightness [13]. Many of the applications use the HSI color model. Image processing applications such as histogram operations, intensity transformations and convolutions operate only an intensity image. These kinds of operations performed with much effectively in the image by using the HSI color space.

$$H = \begin{cases} \theta \ if\ B \le G \\ 360 - \theta \ if\ B > G \end{cases}$$

$$\theta = \cos^{-1}\left\{\frac{\frac{1}{2}[(R-G)+(R-B)]}{\sqrt{(R-G)^2+(R-B)(G-B)}}\right\}$$

$$S = 1 - \frac{3}{(R+G+B)}[\min(R,G,B)]$$

$$I = \frac{1}{3}(R+G+B)$$

CIE Lab: It is one of the perceptual uniform color spaces, and it show how two colors differ to see when human observe that two colors. The uniform color spaces were defined in such way that all the colors are arranged by the perceptual difference of the colors. In these color spaces, the computation of the luminance(L) and the chroma (ab or uv) is obtained through a non-linear mapping of the XYZ coordinates. In CIE*Lab or CIELab, the three component L represent luma component that is illumination information and ab represent the chroma information. L*=0 gives the black color and L*=100 gives white color. The a*, the values a*<0 indicate green while the values a*>0 indicate magenta. The b*, the values b*<0 indicate blue and values b*>0 indicate yellow [8].

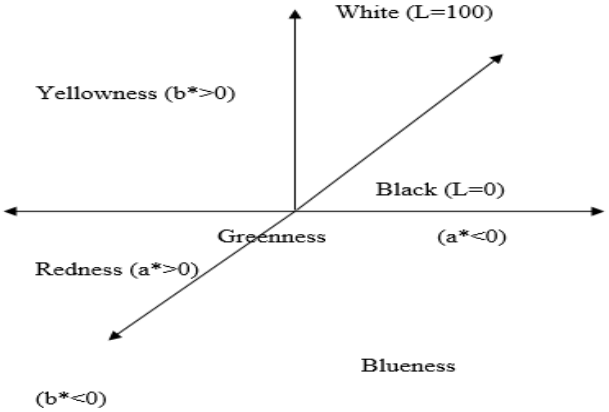


Fig. 2: CIE Lab

2. Review

Many researches carried out different color feature extractions in image processing according to the color models they identified and classified the leaf diseases. This article provides information about how the color feature extractions applied in various researches based on color models and discussed the performance evaluation between the color models.

Color Feature Extraction work

This article described briefly that how the color features extraction approaches involved in various articles for the purpose of leaf disease identification or classification. Firstly, the RGB color model considered from various articles given below.

Juan et al. [14] discussed that leaves image classification in sunflower crops the segmentation is based on RGB color space for clustering of image pixels then features extracted from the segmented image. In order to reduce the segmentation noise the authors followed morphological filtering that is well known dilation or erosion filters. The Generalized Softmax Perceptron (GSP) neural network architecture was used with Posterior Probability Model Selection (PPMS) algorithm for complexity selection to identify them either sunflower or non-sunflower. Hence the discriminative features obtained an average correct classification rate of 85% and proven GSP is better than MLP.

Nurul et al. [15] discussed about statistical approach for recognition of orchid diseases using RGB color analysis. In this study the scale infection and black leaf spot disease of orchid have been chosen. The RGB components are extracted as features and statistical analysis based on error plot and T-test were utilized. Here in statistical analysis the error plot method used to demonstrate variability of data graphically and also used to indicate errors within the extracted features. T-test used here for measuring the statistical significance of two set of independent variables. The authors used to perform the statistical analysis based on the featured extracted from the R,G,B color component for categorization of the two disease type using SPSS software. Hence identification method based on statistical approach namely error plots and T-test analysis shown the two given diseases can be distinguished significantly with color components as feature vectors. This research proposed feature extraction can be used to classify the diseases by RGB color analysis. In future it will be evaluated in field testing or uncontrolled environment.

Prof.Sanjay et al. [16] described about the vision-based detection of plant leaf disease using RGB image created. The RGB is converted into HSI later green pixels masked and removed using specific threshold value. The authors performed the color transformations based on the above steps then the infected regions were segmented into number of patches with equal size. The patch size was taken 32x32. The image segmented and extracted. After that the authors followed the statistics texture and computed using the SGDM. The classification is performed using squared distance technique. Hence this paper has been explained color transformation, masking and segmentation. The future work will be focused on NN's algorithm to increase the rate of classification process.

Sachin et al. [17] proposed an integrated image processing for automated inspection of leaf batches and helped to identify the type of disease. It has four stages like the enhancement includes HSI transformation, intensity adjustment and histogram analysis. The second step was segmentation which includes the adaption of fuzzy c-mean algorithm. The third step was feature extraction includes color, size and shape of spot. The last step was classification which includes back propagation based on neural networks. Spot image features are extracted by using the suitable method in image processing. Some of the morphological characteristics of spot features considered here is length and ratio of principle axes, orientation, gravity, equidiameter, eccentricity, solidity, radius and so on. Here the authors developed an image analyzer to extract the abnormal symptoms of the defected image denoted in size, color and shape of the spot. In the classification phase the inputs were given based on the number of layers, number of neurons for each layer and the minimal number of training samples. The statistical analysis followed based on ANOVA technique. Hence HSI transformation has done using the defected image into HSI. The conclusion states that the proposed system focuses on particular disorder's identification. The future work will be carried out based on robotic expert system.

Basavaraj et al. [18] discussed about the identification and classification of images in medicinal plants, India. Such as herbs, shrubs and trees based on color feature using two classifiers such as SVM and radial basis neural network. The color and edge descriptors have low dimension, effective and simple also discussed. The directional difference and gradient histogram is used. The medicinal images are filtered by Gaussian filter to filter the noise. Here authors classified the medicinal plant based on morphological and structural appearances. In additionally authors have used HSV and YCbCr color spaces for specifying the color histogram. The images are converted into HSV and YCbCr from RGB color space for observing the variance of color spaces. Further authors discovered that HSV color space given more significant color distribution values for classification. The conclusion of this paper found that classification accuracy is better with SVM classifier than NN classifier. Authors suggested that in future this work will be suitable for the classification of medicinal plants in the real world and in pharmaceutical industry.

Guangwen et al. [19] focused on a comparative study of retrieving methods for integrated colors and texture features of image analysis. The authors followed texture parameters are energy, contrast, entropy, correlation and local balance. Here the gray level co-occurrence matrix texture extraction is used and the processes followed converting an RGB image into gray scale image, quantify the gray level, constructing GLCM, texture parameter calculation and normalized parameters. The best feature method discussed is that retrieval based on integrated features. In addition the method GLCM is used because easy to calculate and simple to understand. The color characteristics not showed the spatial characteristics of image. Authors finally chosen multi-feature and is better than the single feature. Further the system should be extended to the network technology.

Miroslav et al. [20] discussed specifically the collaboration of texture and color features with main objective of creating a robust descriptor. The GLCM and Gabor filters used in the experiments. The statistical image analysis is done and used to estimate the properties of image. A grey level method includes grey level co-occurrence matrix and Gabor filters with well known color spaces RGB and HSV used. The proposed method called color level co-occurrence matrices given appropriate results. Authors applied CLCM methods to separate color channels of the color images. In this experiment two color texture database widely used namely MIT Media Lab and the Vistex database. The highest precision for color texture retrieval was obtained by CLCM where reached 90% and described the research on extraction and classification of color texture information.

Sheerin et al. [21] explained the research about analysis of color feature extraction technology in medical imaging. The goal of this research developed a image retrieval system and feature representation is analyzed by using various color spaces HSV, CIE, L*U*V, CIE Lab. Here the image indexing was implemented based on the color descriptors. Similarity matching is analyzed using Euclidean distance, Hamming distance and Histogram intersection. There are various feature extraction techniques applied in this paper. Namely Pixel Based Color Moments Descriptor (PCMD), Color Histogram Moments Descriptor (CHMD), Single Channel Histogram Moments Descriptor (SCHMD) and so on. The experiments results described that the Binary Haar Color Descriptor (BHCD) provided better retrieval results.

Nitin et al. [22] discussed about the detection of plant leaf diseases by a color transformation structure and then green pixels are masked. The RGB is converted into HSI color space then finally the texture statistics is computed by SGDM matrices. The authors proposed a vision based detection algorithm. In the masking the pixel value in an image set to zero or other background values. Later the infected portion of the plant leaf is extracted. Spatial Gray Level Dependencies Matrices (SGDM) method used for extracting the statistical texture features. Hence authors discussed that HSV is a good color descriptor. The segmentation was performed using

32x32 patch size. The extension of this paper will be developed based on neural networks to increase the recognition rate.

Ajit et al. [23] demonstrated computer vision techniques for the identification of leafy vegetables with the mean and range color based. Here authors had chosen 18 color features from RGB and HSI with reverse engineering process for reduction of features. In additionally 12 mean and range features chosen based on the performance. The three layer feed forward Back Propagation NN based classifier for identification of vegetables. This application will be used in automatic vending machines, packaging and measuring of vegetables and food preparation. Developed identification leafy vegetable method tested on 1000 images of 10 different types.

Hrishikesh et al. [24] demonstrated about feature extraction of diseases in leaf. Here the RGB images are converted into HSI color space. At the first step the authors extracted the connected components from original diseased image. Next applied with graph theory then removed the unwanted regions from the connected components which produced a binary image. For feature extraction 10 features considered and segmentation done based on the diseased area. Hence the HSI had given clear discrimination of diseased spot.

Sridhar et al. [25] discussed in details about color and texture based image retrieval in image processing. Here an interactive image recommendation system used color histogram feature. The GCLM texture feature expressed image contents and a kernel based K-means also utilized. The HSV color histogram is calculated and the color feature is extracted from the joint histogram. The HSV color histogram and joint histogram is calculated by using HS (Hue and Saturation) histogram for the total number of pixels. Here authors additionally followed the precision and recall parameters for measuring the extracted features. Chi-square followed to find similarities between the images. In the result part the authors described the color features are compared with equivalent text features. Finally authors concluded that color feature is extracted from join histogram and given the increasing curve for the query image.

Fatemeh et al. [26] discussed about a new color feature extraction based on color distribution entropy is presented effectively described the spatial information of colors. Here the authors proposed dynamic color distribution entropy of neighborhoods method. Dynamic color distribution entropy of neighborhoods method is based on color distribution entropy and effectively describes the spatial information of colors. Authors resized the images into 128x128 pixels because images makes noises removed and reduced small neighborhoods. The images are indexed by dynamic color distribution entropy neighborhood descriptor and in HSV color space with quantized into 8 levels of hue, 2 levels of saturation and value given 32 bins. Here the problems were identified and introduced a vector space retrieval method. The similarity measurement done by vector space retrieval method and experiment carried with the help of databases of 1000 and 6384 images. The experiment demonstrated the acceptable efficiency of the proposed approach.

Aibinu et al. [27] proposed an analysis of ANN based skin detection using YCbCr color space. The images of skin acquired from various applications based on facial and human recognition systems. Results shown the YCbCr color space is better than RGB color space. To avoid the concentration of constituents increases based on skin roughness shown the difference. Here various forms of color space techniques have been followed namely RGB, YCbCr, HSV, CMY and CMYK. The relationship between RGB and YCbCr color space expressed clearly with performance analysis of skin detection by YCbCr has been evaluated. A skin pixel region identification with fixed threshold technique was proposed. The results of this paper explained YCbCr color model performs better than RGB color. Further ANN based YCbCr shown better performance and increase the accuracy of the system for identification of skin pixels.

Sonal et al. [28] addresses classification of cotton leaf spot disease by using SVM. The authors explained how the quality of agriculture products may be reduced from many of disease causes. Images captured based on its symptoms and categorize the diseases using SVM. An segmentation technique was implemented and color feature extraction also used to extract features of cotton diseased spots. Here the cotton leaf images were taken by color camera and images were converted into a grayscale. Further the gray level threshold segmentation was applied then the binary image taken. A median filter and morphological operators used to remove unwanted spots in the leaf. The color difference is evaluated using Euclidean distance. The proposed technique is based on the CIELab color space and the authors converted RGB color components to CIELab color component. Classification done through SVM based on number of weight vector in the cotton color leaf.

Pramod et al. [29] described about detection and classification of plant disease based on vision related algorithm. First the image was converted from one component to another form. That is RGB images were converted to HSI color space then the authors identified most green colored pixels. Later green pixels are masked and removed the pixels with zeros. It given more accurate disease classification and reduces processing time. The NN used based on back propagation algorithms for the classification. The leaves which are affected by disease shown significant differences when compared with the normal leaf. The extension of this paper focused developing more on genetic algorithms and neural network in order to increase the recognition speed and accuracy.

Sanjay et al. [30] addressed an implementation of face detection algorithm of robust color skin. Here the authors followed face detection algorithm based on color skin RGB, YCbCr and HSI are considered. Comparative study made based on the color spaces algorithms and combined with new skin color face detection algorithm. Authors proven that the algorithm localizes the face more effectively. The skin region is detected using a normalized color histogram. Three algorithms combined and given skin region.

Pradnya et al. [31] described about leaf disease detection in grape with analysis of SGDM matrix method. The several analytical discriminating techniques are used to classify and vision based detection algorithm also followed. Initially the RGB color leaves converted into HSI. Next identified the mostly green pixels and threshold value is computed based on Otsu method. Later the infected region is segmented into number of patches. Here the authors followed color co-occurrence method for extracting the feature. The color co-occurrence was developed with the help of spatial gray level dependency matrices. Two texture features computed followed shade and cluster prominence. Hence co-occurrence features obtained and shown significant differences can easily categorized. The extension of this work will be focused on hybrid algorithms like genetic algorithms and neural network in order to increase the identification rate and classification.

Guili et al. [32] discussed about use of color leaf images to identify the deficient tomatoes in modern agriculture. In this paper computer vision is presented based on a novel idea in color feature extraction by extracting leaves using percent intensity histogram and percent differential histogram, Fourier transform, genetic algorithm and so on. One or two features are not enough due to the complication so multi-angle color and texture features were extracted. The intensity feature was extracted and identified through visual inspection. The intensity percentages calculated and simultaneously the intensity features were determined. Further the fourier transform was applied to extract period character of disease through frequency domain. In additional the wavelet packet decomposition used to extract transient abnormal signal. The authors classified the framework based on binary tree. Experiments shown accuracy is more satisfactory.

Madhura et al. [33] discussed for image retrieval in the feature extraction based on color spaces as well as GLCM. Here authors followed GLCM due to the large size of images used in the databases in order to extract the texture features. The color feature extraction also used to retrieval of images by RGB, HSV and YCbCr. Authors discussed about both color and texture features which is under general features or low level features. The domain specific features or high level features like emotions are difficult to extract. So this experiment has been used to evaluate the effects of different color spaces on model performance. The co-occurrence matrix was used for texture feature image retrieval. The authors chosen Euclidean distance measurement for similarity measurement. Here the performance evaluation metrices followed an precision-recall method.

Hence image is retrieved based on color and texture feature given best results using precision and recall graph analysis.

Michele et al. [34] has explored in the paper about low-level color and texture feature extraction. The authors followed content based image retrieval technique to visualize the content of an selected images for similar images in large databases. Here the comparison studies between color extraction algorithms and texture feature algorithms discussed. In the color feature extraction the conventional color histogram, fuzzy color histogram, color correlogram and color based method were implemented and compared with texture features algorithms like steerable pyramid, contourlet transform, gabor wavelet transform and the complex directional filter also compared. The color feature extraction is performed in the HSV color. The four texture feature presented here generated a multi-scale, multi-directional representation of an image. Authors performed simulations and the HSV color space. The mismatches were computed and average retrieval score for all the classes were computed. Hence the fuzzy color histogram and gabor wavelet transform given highest color and texture results. Future work will be explored with combining color and texture features additionally with user-feedback into the system.

Miroslav et al. [35] has discussed in detail about color texture features based on GLCM. In this paper color GLCM proposed and compared with other methods. Here the extraction based on gray scale images also with gabor filters. The RGB and HSV color models used for color texture features. Authors followed 5 scales and 6 orientations in the texture. One of the special type here followed color GLCM. The feature vector is compared with all images in the database and also similarity found by the minimal Euclidean distance. Hence Gabor filter provided more retrieval of color textures. Therefore Color GLCM obtained similarity higher than GF.

Table 1: Performance Analysis of Color Feature Extraction on Various Images

No	Author	Year	Method Used	Accuracy	Benefits
1	Juan et al [14]	2011	Color transform, NN, Posterior Probability Model Selection	90%	Leaf Classification
2	Nurul et al [15]	2012	RGB Color analysis, Error plot, T-test	92.3%	Identification of leaf spot
3	Sanjay et al [16]	2013	Color transform, CCM, SGDM	90%	Leaf disease detection
4	Sachin et al [17]	2014	HIS transform, Histogram analysis, Fuzzy c-means algorithm, BPNN	91.46%	Image analyzer with pattern recognition for disorder's identification
5	Basavaraj et al [18]	2010	Color and Texture feature, SVM & NN Classifier, Edge direction histogram	90%	Identification and Classification of Medicinal plants
6	Guangwen et al [19]	2012	Color transform, GLCM texture feature analysis.	87.3%	Multi-feature image retrieval
7	Miroslav et al [20]	2014	GLCM, Gabor filters, SVM, Color-Level co-occurrence matrix	90%	Color texture classification
8	Sheering et al [21]	2010	Color feature extraction, Euclidean distance, Histogram intersection and Hamming distance	85%	Feature representation, efficient indexing and similarity matching
9	Nitin et al [22]	2013	Binary fission, Color transform, SGDM	91.4%	Texture statistics for detecting plant leaf
10	Ajit et al [23]	2012	Computer vision techniques, Color transform, BPNN classifier	100%	Identification and Classification of leaves
11	Hrishikesh et al [24]	2014	Color transform, Connected component labeling,	91.2%	Leaf feature detection
12	Sridhar et al [25]	2012	GCLM, Kernal based K-means, Color transform, Chi-square, Precision and recall,	92%	Image retrieval using color and texture features
13	Fatemeh et al [26]	2011	Color histogram, Color distribution entropy, Vector space retrieval	92%	Color feature image retrieval
14	Aibinu et al [27]	2012	ANN, Color transform	95%	Skin detection and Performance analysis
15	Sonal et al [28]	2014	Support vector machine, Texture feature, Color feature	93%	Identification of affected part of the disease, classification
16	Pramod et al [29]	2013	Color transfor, NN	94%	Plant disease identification and classification
17	Sanjay et al [30]	2003	Color transform, Color based face detection algorithm	95.18%	Face detection
18	Pradnya et al [31]	2014	Color transform, SGDM, Color co-occurrence method, Vision related algorithm	92.8%	Detection of leaf diseases
19	Guili et al [32]	2011	Color transform, Intensity histogram, Percent differential histogram, Fourier transform, Wavelet packet and Genetic algorithm	96.25%	Diagnosis and identification of deficiency
20	Madhura et al [33]	2013	Color transform, Texture feature, Hybrid feature extraction, GLCM, Precision and recall graph analysis	96%	Image retrieval
21	Michele [34]	2008	Color transform, CBIR, Contourlet transform, Gabor wavelet transform, Complex directional filter bank	92.17%	Image retrieval based on content
22	Miroslav et al [35]	2007	Color transform, Color GLCM, Gabor filters,	91%	Color texture feature extraction

3. Conclusion

There are many applications based on color feature extractions such as leaf classification, Orchid disease identification, agriculture plant leaf detection, morphological detection, combined color texture, integrated with color and texture extraction, GLCM based identification, image retrieval system, crop disease detection, Indian leaf vegetables identification, dynamic color distribution, skin detection with ANN, cotton leaf spot detection with SVM, automatic detection and classification, face detection, grape leaf detection with SGDM, identification of deficient tomatoes, content based image retrieval, color texture feature extraction and so on. Several methods have been proposed in the past researches for extraction of leaf diseases. These approaches described the different color spaces related to the leaf diseases or patterns in an image such as RGB, YCbCr, HIS, HSV, CIE Lab etc with different attributes of an image like color, pattern, shape, contrast, region, connected-components also considered. This survey exposed a performance comparison table of different techniques were proposed earlier for color feature extraction in the images. The discussed approaches have its own advantages and disadvantages. However, there is no single approach specified so far that fits for all the applications. In future, this work will be extended to give more importance for developing an algorithm to get exact and fast color extraction from an image.

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