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Clasification of Skin Disease for Teledermatology using Image Processing

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Abstract— **Modern Image Processing methods can be utilized in a number of applications to solve varied problems. Combined with Machine learning and classification techniques they can be used to automate several applications. Teledermatology is one such application which solves the problem of manual detection and identification of diseases. Due to lack of adequate medical facilities in a developing country like India with huge population, its sometimes not possible to provide timely medication, especially in some common skin diseases which lead to them become chronic. In this research paper, a method has been proposed to identify and detect three common skin diseases prevalent in India viz. Acne, Eczema and Psoriasis. The proposed system uses Support Vector Machine algorithm to classify the diseases and reaches up to 87% accuracy.**

Keywords— Skin Disease, acne, eczema, psoriasis, classification.

I. INTRODUCTION

Skin diseases are common in everyone, and various types of infections are becoming more common. It's a proven fact that all of these diseases are extremely dangerous, especially if not treated promptly. Skin disease being one of the common and widespread ailment among the masses and cause of misery for a number of people. Such disease are curable and can be easily preventing from spreading from person to person if timely identified and cured. Skin diseases do more than just harm the skin. It can have a significant impact on a person's daily life, destroying confidence, impeding movement, and leading to depression. Many people will sometimes try to treat their allergies with their own therapy. However, if these methods are not appropriate for that type of skin disease, it will exacerbate the problem. There are people living in remote areas with limited or no access to quality medical and healthcare facilities.

All these problems calls for development of system which can accessible to a large number of people and provide non invasive methods for curing the common skin disease types.

Teledermatology is an application of technology,communication and healthcare facilities to provide remote medical facilities without reaching to the doctor. The modern image processing techniques combined with machine learning methods can be utilized to develop a completely automated and all accessible model to aid the people in getting timely and expert medical advice.

Goel et.al[1] developed a realtime embedded system based technique for various disease like melanoma, basal cell carcinoma, actinic keratosis and squamous cell carcinoma.

Sumithra et.al [2] used GLCM features and classification using SVM-KNN hybrid method to classify skin diseases such as melanoma, bullae, seborrheic keratosis, shingles, and squamous cells.

Taufiq et.al[3] presented LBP-GLCM feature extraction method.

Lahijania et al[4] used SVM-kNN with multilayer perceptron, these features are used to classify skin diseases such as psoriasis, seborrheic dermatitis, lichen planus, pityriasis rosea, chronic dermatitis, and pityriasis rubra pilaris.

Victor et.al[5] used active contour-based marker control watershed algorithm, and statistical GLCM features.

Ajith et al[6] used Discrete Cosine Transform, Digital Wavelet Transform and singular value decomposition.

Abdulbaki[7] developed genetic algorithm with BPNN, classify different eczema-like: allergic contact eczema, contact eczema, dyshidrotic eczema, neurodermatitis, nummular eczema, seborrhoeic eczema, and stasis dermatitis. Canny Edge detection was used for edge detection.

Priya et.al [8] employed a bottom-hat filter and Otsu thresholding method and morphological operations (dilation-erosion). The ABCD rule is used to classify skin diseases as benign, suspicious, or malignant melanoma, but system accuracy is not mentioned.

Hameed et.al [9] used Otsu thresholding method for segmentation. For feature extraction, the method employs various colour models, GLCM, and the neighbourhood gray-tone difference matrix (NGTDM). The SVM (quadratic kernel) classifies skin diseases such as acne, eczema, psoriasis, benign and malignant melanoma, and so on.

Arasi et al. [10] proposed DWT based system to ensure high accuracy. In this case, the wavelet divides the image into four sub-bands: approximation, horizontal, vertical, and diagonal. PCA and Naïve Bayes are used for feature extraction and classification respectively.

Ahmad et.al[11] used hybrid genetic algorithm with ant colony optimization (ACO-GA) algorithm. For feature extraction and classification, the GLCM and transductive SVM (TSVM) algorithms are used.

The main purpose of this research work is to present an implementation of a skin disease diagnosis system that assists users in detecting human skin diseases and providing medical treatments on time. This system detects skin diseases using image processing and machine learning technologies.

In this research three primary occurring diseases viz acne, eczema and psoriasis which are most prevalent in India have been discussed. The algorithm consists of the training part in which a database is created of the features taken out of images of the three diseases. This training database consists of Gray Level Co-Occurrence matrix(GLCM) features. IN the testing and classification phase the input skin images are processed and features are extracted and then compared to the existing features database using SVM classification.

In the following sections, the methodology and techniques are discussed in section II, followed by a description of the dataset of the three diseases in Section III, Result and Discussion is discussed in section IV and finally Section V presents the Conclusion.

II. METHODOLOGY

A. Image Resizing & Contrast Enhancement:

The input images are firstly resized to make convert them into a standardized form and then contrast enhancement is applied to improve their brightness and contrast. These are the preprocessing steps applied on all the input images. The images have been resized to 256x256 pixels. The image contrast enhancement is done by saturating the top 1% and bottom 1% pixel values. Thus the pixel intensity of all the pixels are enhanced. Image enhancement is carried out for increasing the contrast. the RGB images into the grey images using color conversion using equation 1.

$$f(x)=0.2989*R + 0.5870*G + 0.114.*B \quad (1)$$

B. Segmentation:

Otsu method and k-means clustering is applied on the images to segment te image according to the different image characteristics. The images are first converted to binary form anf ten converted from RGB to HSI format. Color transformation structure for the RGB image is created and then, a device-independent color space transformation for the color transformation structure is applied. The image space is converted from RGB to l*a*b space. The k-mens clustering is applied on it to segment the image. Tis method segments the image into various regions and then asks for a manual input from the user to identify the Region of Interest according to the spread of the disease.

C. Feature Extraction:

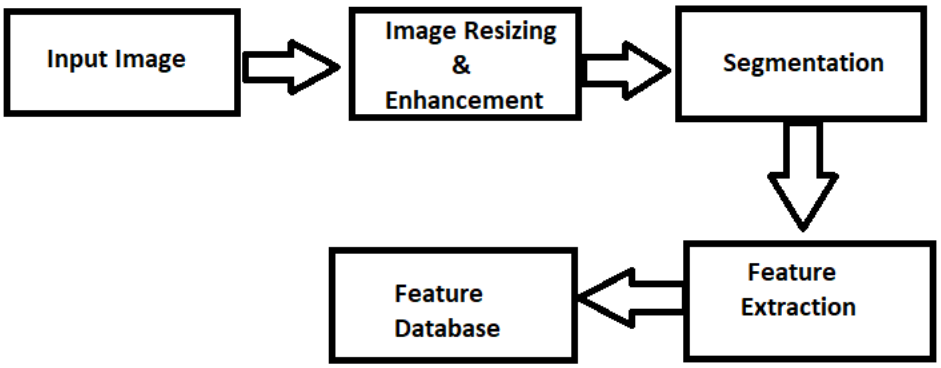
Feature extraction plays an important role for identification of an object. In this work, Color co-occurrence Method both color and texture are taken into account to get an unique features for that image. For that the RGB image is converted into the HSI translation. For the texture statistics computation the SGDM matrix is generated and using GLCM function the feature is calculated. Once the features have been extracted, then these features are to be used to classify and identify an object using SVM classifier to classify the different disease types. GLCM features which has been used in this work are Contrast, Correlation, Energy, Homogeneity, Mean, Standard Deviation, Entropy, RMS (root mean square) contrast, Variance, Smoothness, Kurtosis, Skew ness, IDM (Inverse difference-measure). These features are extracted from all tnhe disease image files and a training database of the disease data is formed using these features. Also the class label are applied to each type of disease.

D. Testing and Classification

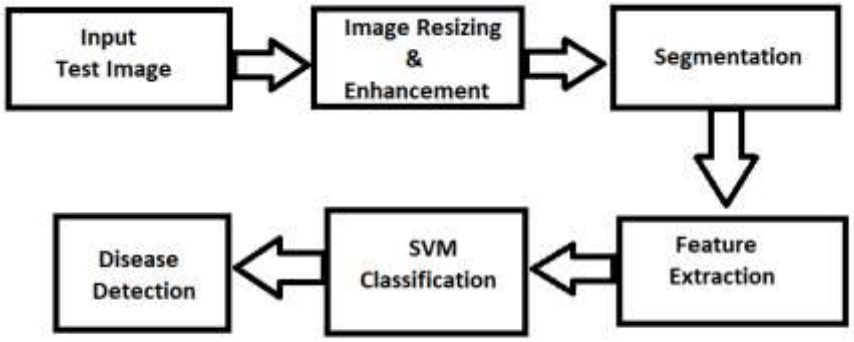
In this final phase, feature matching is done to detect the presence of disease. Comparison of feature vectors to the various models and find the closest match is performed. One can match the feature vectors obtained in training set. After the extraction of all the necessary features, we have to compare them with our pre-calculated dataset stored in the database. We have used the SVM (Support Vector Machine) classifier for classifying the disease.

Support vector machines (SVMs) are a set of related supervised learning methods used for classification and regression. Supervised learning involves analyzing a given set of labeled observations (the training set) so as to predict the labels of unlabeled future data (the test set). Specifically, the goal is to learn some function that describes the relationship between observations and their labels. More formally, a support vector machine constructs a hyper plane or set of hyper planes in a high- or infinite-dimensional space, which can be used for classification, regression, or other tasks. Intuitively, a good separation is achieved by the hyper plane that has the largest distance to the nearest training data point of any class (so-called functional margin), in general the larger the functional margin the lower the generalization error of the classifier.

Multiclass SVM aims to assign labels to instances by using support vector machines, where the labels are drawn from a finite set of several elements. The dominant approach for doing so is to reduce the single multiclass problem into multiple binary classification problems. Figure 1 shows the complete flow diagram of the methodology used in tn his research work.



(a)



(b)

Figure 1: Methodology (a) Training (b) Testing

Figure 1 shows the block diagram of training and testing phase used in this research work.

III. IMAGE DATASET

Figure 2: Acne Images

Figure 3: Eczema Images

Figure 4: Psoriasis Images

Figure 2,Figure 4 and Figure 5 shows the images of the various diseases used in this research work, Figure 2 shows acne images, figure 2 shows eczema images and figure 3 shows the psoriasis images.

These images have been taken from the dermnetnz.org website which consists of several thousand images related to various diseases.

IV. Result and Discussion

The system has been simulated using MATLAB/SIMULINK software. Image Processing Toolbox consists of functions which are used in this research work.
The dataset consisting of images of various disease images consisting of 10 images of each of acne, eczema and psoriasis is taken and according to the block diagram shown in figure 1. The results of various steps is as shown below.

Figure 5: Input acne Image

Figure 5 shows the Input acne image. The image is resized to 256x256 and enhanced to improve the contrast of the image. Figure 6 shows the result of contrast enhanced and resized image. K-means clustering is then applied to classify the various different color segments within the image.

Figure 6: Resized and Contrast Enhancement

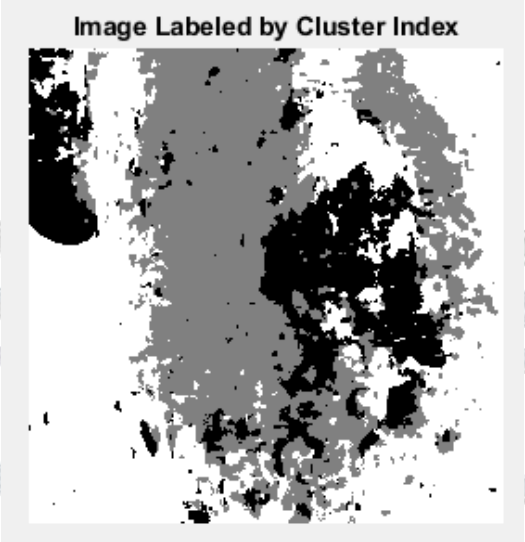


Figure 7: Cluster Based Labeling

Figure 7 shows the cluster based labeling on the image of various different classes of pixels.

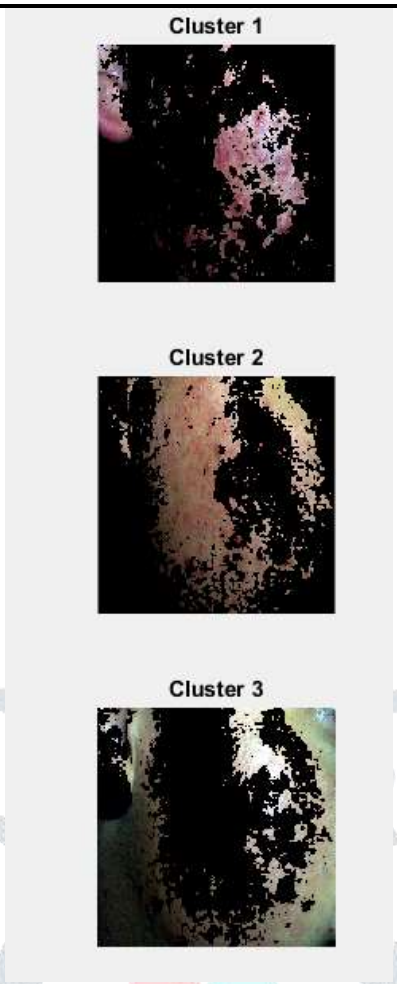


Figure 8: Cluster Images

Figure 8 shows the cluster images based on the k-means cluster results. As can be observed Cluster 3 shows the maximum region of interest consists of acne. This cluster is thus selected for further processing. Figure 9 shows the gray scale converted image of the selected cluster. The GLCM properties features are extracted from this image and stored to make the feature database.

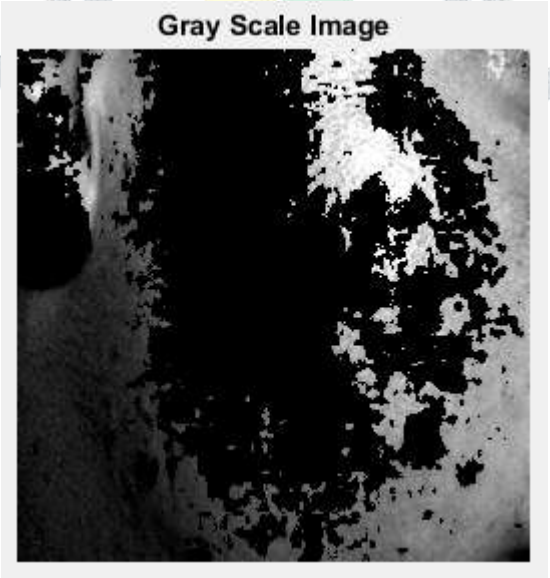


Figure 9: Gray scale Converted Selected Cluster

The testing phase comprises of similar process of image preprocessing and feature extraction and then the SVM classification has been applied to salsify and detect the type of disease in the input test image. The accuracy of system for SVM classification is 86.66%.

IV. CONCLUSION

In this paper image processing and machine learning techniques have been used to device an algorithm for providing automatic classification of three major skin diseases prevalent in India viz acne, eczema and psoriasis. Often, these diseases are not treated in time and take the form of chronic disease. The motive of this research work is to develop an automated methods

which can help people detect and understand the type of disease just by inputting the image to the system. The preprocessing methods have been applied on the input image to standardize them in terms of size and contrast. Then k-means clustering algorithm is applied to segment the image into various color pigment based clusters. These clusters are then manually classified to find the region of interest. Then GLCM features are evaluated on these clusters and a database of GLCM features is created. In the testing phase the input image is classified and tested using the SVM classification technique. The system results into high accuracy of 86.67 %.

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