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Automatic prediction of skin lesions using MLWT analysis and SVM classifier

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ABSTRACT

This paper presents melanoma and non-melanoma skin lesion classification using hybrid features representation and support vector machine classifier. The CAD system employs automatic skin lesion classification based on texture feature extraction using Multi level wavelet transform and DRLBP analysis. Wavelet based entropy and DRLBP histogram features are utilized for image analysis and it is used to recognize the pattern. The SVM classifier will be used to classify the queried images automatically to decide the stages of abnormality. Support vector machine classifier is based on supervised learning and non-knowledge based classification. Finally, Classified Skin lesions images are segmented using dual thresholding to extract lesion part from background.

KEY WORDS: SVM Classifier, DRLBP, Multi-level wavelet transform

1. INTRODUCTION

Skin neoplasm is an unwanted growth in the skin which has various causes and different degrees of malignancies. Skin cancer spread over all parts of the human body through blood or lymphatic system. Morbidity and Mortality can be reduced if Malignant Melanoma is detected at early stages. Usually skin cancer begins with skin lesions. Melanoma and Non-melanoma are the two types of skin cancer. Non-Melanoma type includes Melanocytic Nevus / Mole (ML), Seborrhoeic Keratosis (SK). Melanoma type skin lesion include Actinic Keratosis (AK), Basal Cell Carcinoma (BCC), Squamous Cell Carcinoma (SCC).

The most common type of skin cancer is the BCC, which originates from the basal keratinocytes of the epidermis. The second most common type is the SCC, Which arises from the epidermal keratinocytes. The third most common type is the malignant melanoma and death is caused by the second type of skin cancer. The largest organ of the human body is the skin and it is our first line of defense. The three layers of skin include epidermis, dermis, and hypodermis (also known as subcutis). Keratinocytes are mainly present in epidermis. It also includes melanocytes, which are cells responsible for skin pigmentation, which also provides protection against sun's rays.
For human skin color variation Melanin is the important pigmentation factor. To classify the skin lesions or to detect abnormal streaks in skin several methods exists. The existing methods include Feature extraction, Classification of cancer. These methods are used to study, diagnose, and treat various type of melanoma skin lesions.

Literature Survey: A.K-Nearest Neighbours based classification

Nearest Neighbour Algorithm is one of the most straightforward instance-based learning algorithm. In K-NN the training Phase helps to store known instances and their class labels. N-fold cross-validation is been used on the training dataset and it helps to tune the K-value and perform feature selection. The K-nearest instances is been located by the K-NN to the query instance. To classify the melanoma skin lesions K-Nearest Neighbours classification is a non-parametric method. The input includes the K-Closest training samples. Class membership is the output. Three distinct K-NN classifier systems is present in the HKNN. The top level includes only one and the bottom level includes two. All the images in the training set is fed into the top level classifier.

The other two classifiers are trained by the images, which are classified by the top classifier. The learning phase includes the feature selection process with three distinct K-NN classifiers. The maximization of the classification accuracy is the goal for choosing features. For the uneven class distribution of our data set we used weighted classification accuracy. The nearest neighbour in instance space is located in the learning process.

2. METHODS

Methodology: The proposed method includes the SVM classifier, which is used for the process of classification. MLWT-DRLBP are used for the process of feature extraction. The SVM classifier is an final stage of classification and the built in features of the test image is given as an input and finally the segmentation process takes place, which segments the classified cancer to determine the stages of abnormality. The implementation stages include preprocessing, MLWT-DRBLP, SVM Training and classification, segmentation.

The test image also known as the input image is used to determine the type of cancer. Preprocessing takes place, the built features are extracted such as energy, mean, correlation co-efficient, entropy. Similarly the same features are extracted from the training samples. Five pre-defined images for five type of cancer and one for normal are present in the training samples. Each type of cancer consists of various probability values. These training samples with the probability values are given to the SVM classifier to classify the cancer.

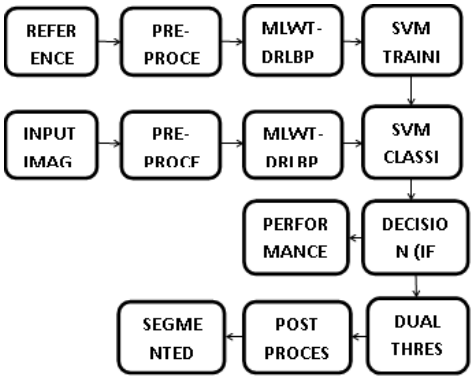


Figure.1.Basic Block Diagram

Getting the result of a test image to the each training samples feature values are related in the SVM classifier. If the experimented samples value is equal to the getting the feature values it notes the probability of that training sample. At the final stage the higher probability value which matches the test images is taken.

The type of cancer is determined with the help of the probability value and the resultant image will be segmented to obtain the abnormality stage. In the segmentation Dual thresholding with Morphological filtering is used.

Multi-Level Wavelet Transform: Wavelet Transform is a kind of representation of signal that can give the frequency content of the signal at a particular instant of time or spatial location. The daubechies based wavelet transform type decomposes the image into various sub band images. It helps to split the component into numerous frequency bands known as sub bands. The sub bands are MM, MN, NM, and NN sub bands. A high-frequency sub band contains the edge information of input image and MM sub band contains the clear information about the image. The decomposition will be done for four level to extract the texture features effectively for training process. Then entropy will be measured for all decomposed sub bands to make feature vectors at stage one.

Wavelet Computation

Step1: To get M and N Row wise processing is used.

$M = (R_o - R_e)/2$ and $N = (R_e + R_o)/2$

Where R_e and R_o is the even Row and odd Row wise values of pixel

Step 2: To get MM, MN, NM, and NN Column wise processing is used.

Separate odd and even columns of M and N,

Namely, M_o- odd column of M, N_o - odd column of L

M_e- even column of M, N_e- even column of N

$MN = (M_o - M_e)/2$ $MM = (M_e + M_o)/2$

$NN = (N_o - N_e)/2$ $NM = (N_e + N_o)/2$

Entropy Measurement: Entropy provides a measure of the image complexity. Complex textures tend to have higher entropy. The texture feature, entropy will be measured from high frequency subbands of four level discrete wavelet transform. Along with these, discriminative robust local binary pattern of skin texture are extracted. Finally grouped features are utilized for machine learning training and its classification.

DRLBP Descriptor: The pixel values are compared using the descriptor local binary pattern. The pixels includes the center pixel, which consists of the neighboring pixels in the kernel to improve the robustness against the illumination variation.

The gradient vector is used to weigh the upper and lower robust LBP codes to generate the histogram of discriminative robust LTP and DRBLP is represented in the form of Normalized histogram. The local edge texture of finger print invariant to contrast and shape changes can be discriminated using DRBLP.

SVM Classifier: For image classification, the classifier used is the SVM (support vector machine).The SVM includes Radial basis function as a kernel function. It is non-knowledge based supervised learning classifier. Before the training of SVM classifier training sampled feature vectors and its group values are determined. The SVM model are been fed with the training sample features which consists of assigned target vectors in order to obtain information about the trained classifier including support vectors. At the final stage, the trained SVM classifier simulates the test image features to make decision of skin image like non-melanoma or melanoma lesion.

Classification: The training of SVM consists of reference features set and desired output using 'svmtrain' command. The desired output consists of 1 normal and 5 abnormal case. Next to the training phase, the updated weighting factor and biases with other netrwork. Parameters are stored to simulate with input features. The test image features are utilized to simulate with trained SVM model using 'svmclassify' at the classification stage.

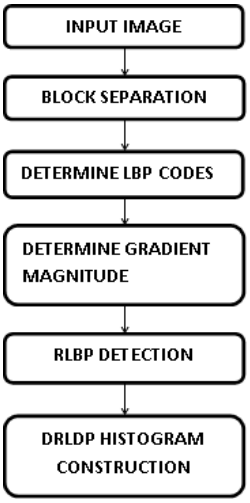


Figure.2. DRLBP Flow chart

Performance Metrics

The classifier performance can be evaluated through following parameters,

Sensitivity: It measures the capacity of actual positives which are correctly identified.

Sensitivity= Tp/(Tp + Fn)Where,

Tp = True Positive:Abnormal correctly classified as Abnormal

Fn = False negative:Abnormal incorrectly classified as normal

Specificity: It measures the capacity of negatives which are correctly identified.

Specificity = Tn/(Fp + Tn)Where,

Fp = False Positive:Normal incorrectly classified as Abnormal

Tn = True negative:Normal correctly classified as normal

Total accuracy: (Tp+Tn)/(Tp+Tn+Fp+Fn)

Image Segmentation: The process of partitioning an image into non-intersecting regions is known as image segmentation. Each region is homogeneous. In segmentation process thresholding method is used. This method extracts the lesion region from skin image based on threshold values for intensity plane of input skin images. Lower and higher threshold values used to segment the image to get two sets of pixels B (all the pixel values are less than T) and N (all the pixel values are greater than T). After that segmented image will be applied to morphological erosion process to remove the unwanted pixels from background region.

3. RESULTS

The classification of cancer is been provided by the implementation of SVM classifier to the test and training images. Finally the region of cancer is shown with the help of segmentation as an highlighted region and it provides the abnormality stage and type of cancer.

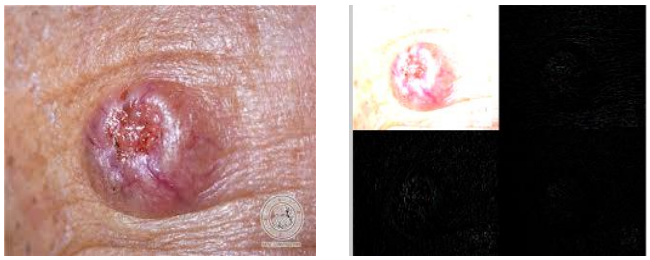


Figure.3. Basal Cell Carcinoma

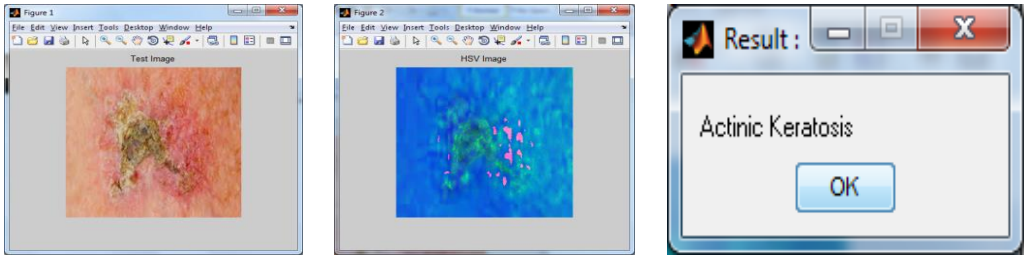


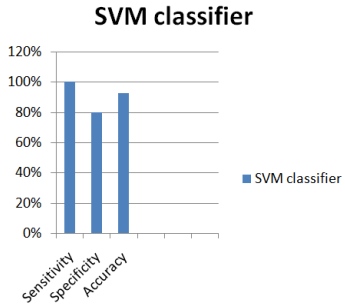
Figure.4. Classification of Actinic Keratosis

Figure.5. Segmentation of Actinic keratosis

Table.1. Classifier Performance

Parameters	SVM Classifier
Sensitivity	100%
Specificity	80%
Accuracy	92.3077%

Figure.6. SVM Classifier



4. CONCLUSION

This algorithm has been applied on many images and successful detection, classification of cancer region has been found and it determines the abnormality stages.

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