International Journal of MC Square Scientific Research Vol.11, No.3, 2018

Melanoma Classification Using Multiwavelet Transform and Support Vector Machine

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Abstract:

The skin exposed to the sun is the main cause. It spreads very fast, so early diagnosis of skin cancer is required for affected persons. In this study, an efficient method for Melanoma Skin Cancer Classification (MSCC) system is presented. MSCC system uses wiener filter for preprocessing, Multi Wavelet Transform (MWT), statistical features (mean, standard deviation and variance) for feature extraction and Support Vector Machine (SVM) classifier is used for classification. Initially, the input melanoma images are given to wiener filter to remove the hair in the skin. The preprocessed melanoma images are decomposed by MWT. The subband coefficients of MWT are extracted by mean, standard deviation and variance. Finally, SVM is used for the classification of melanoma images into normal and abnormal. Performance of MSCC system is measured by classification accuracy, sensitivity and specificity by using MWT and SVM.

Keywords: Melanoma Skin Cancer Classification, Multi Wavelet Transform, Statistical Features, Support Vector Machine

1 Introduction:

Melanoma detection and classification in image processing is discussed in [1]. The input melanoma images are preprocessed by enhanced and color space method. The segmentation is made by grabcut algorithm. BPNN is used for classification. Melanoma recognition using feature selection method is discussed in [2]. The preprocessing is made by color space transformation and image enhancement technique. Grabcut method is used for segmentation. The features like solidity, aspect ratio, circularity, shape skewness, kurtosis, entropy and variance features are extracted. K-nearest neighbor classifier is used for classification.

Melanoma early detection for MSCC system is described in [3]. The input image is preprocessed by image acquisition method. The features are extracted by entropy, energy, homogeneity, cross correlation and contrast is extracted. The multiclass SVM is used for classification. Supervised and unsupervised learning for MSCC is discussed in [4]. Input melanoma skin images are preprocessed using conversion of gray image and median filter. The features are extracted by using k-means clustering technique and classified by SVM.

Hidden markov tree features based melanoma classification is presented in [5]. Initially, input skin images are decomposed by wavelet transform and classified by hidden markov model. Skin lesion images segmentation and MSCC is explained in [6]. The input skin images are preprocessed by using median filter and image acquisition is also done to remove hair in the skin. The segmentation is made by k-means clustering. The features like circularity, equivalent, solidity, extent, variance and average of gradient magnitudes are extracted. Classification is made by decision tree, k-nearest neighbor and SVM classifier is used.

MSCC system using MWT and SVM is presented in this study. The organization of paper is as follows: The methods and materials used for MSCC system is presented in section 2. Experimental results and discussion of melanoma skin cancer classification is discussed in section 3. The last section concludes the MSCC system.

2 Methods and Materials:

MSCC system workflow is shown in figure 1. The input melanoma images are given to wiener filter for preprocessing and hair removal. MWT is used for decomposition the input melanoma images and it produces subband coefficients. These subband coefficients are extracted by mean standard deviation and variance. SVM classifier is used for the classification of MSCC system.

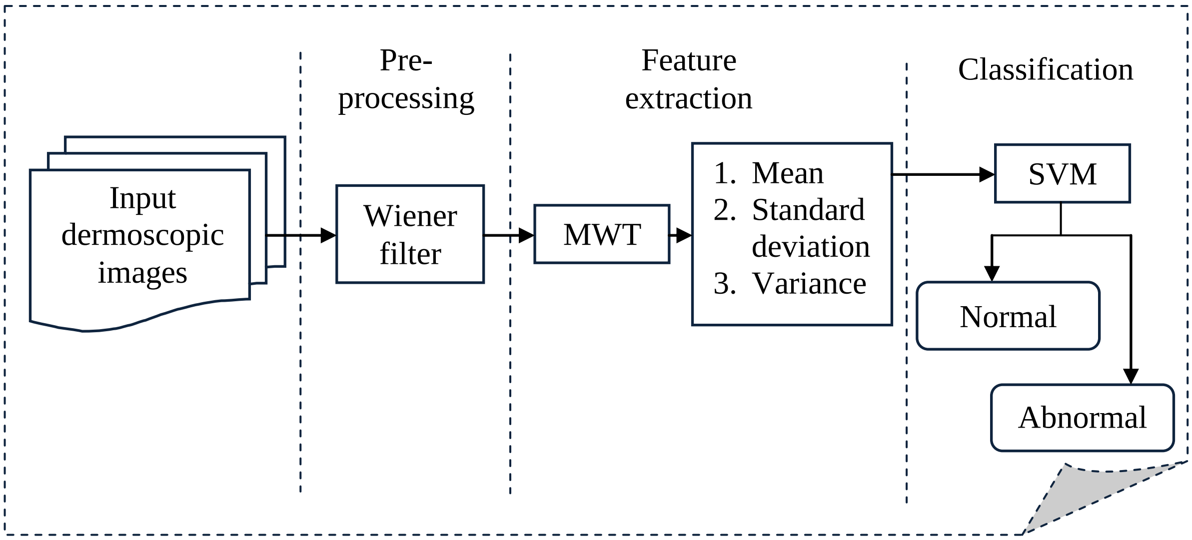

Figure 1 MSCC system-workflow

2.1 MWT feature extraction

MWT has mother wavelet and one scaling function for the representation. It is a standard form of wavelet transform. It has the symmetry, compact support, orthogonality and originality properties are used to develop the MWT. It is also used in image compression [7] and image coding [8]. It needs two or four filters. Then the factor of down sampler is also four. It has more loss of information. The prefilter is used for the downsampling process for splitting it into two stages. MWT has better result in terms of complexity design and loss of information. The vector inputs are produced by the prefilter. The prefilter is used for the decomposition of MWT for images. In this study, MWT is used to decompose the input melanoma images and it produces the subband coefficients. These subband coefficients are extracted by mean, standard deviation and variance, then used for classification of melanoma images.

2.2 Melanoma Classification:

SVM is a supervised learning model that is used for the analysis of regression and classification. It is a non probabilistic binary linear classifier. SVM classifier is also used in brain image classification [9] and remote sensing classification [10]. SVM also uses one versus one approach. It uses hyper plane for binary classification. The representation of SVM model is mapped in to the separate categories and divided as wide as possible. It also used in multiclass classification in various applications. The SVM classification is derived by,

$$\min\left[\frac{1}{2}\|p\|^2+\frac{1}{cd}\sum_{k=1}^{d}\psi_k-H\right] \tag{2}$$

where ψ the slack variable for misclassification, H is the bias and k is the number of examples. In this study, MSCC system uses SVM classifier for the classification.

3 Results and discussion:

The PH2 database [11] is used for the performance evaluation of MSCC system. The database consists of 100 dermoscopic lesion with the resolution of 768x560 pixels. Some of the sample images in the PH2 database are shown in figure 2.

(a) Normal **(b) Benign** **(c) Malignant**

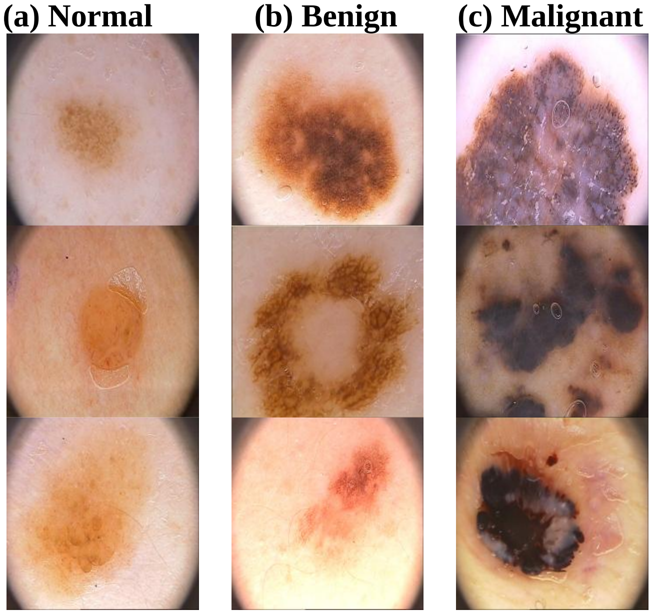

Figure 2 Some sample images in PH2 database

The input images are preprocessed by wiener filter and preprocessed image is given to MWT for decomposition and also it produces the sub-band coefficients. The subband coefficients are extracted by mean, standard deviation and variance. These extracted features are given to SVM for classification. Performance of MSCC system is measured in terms of accuracy, sensitivity and specificity. Table 1 shows accuracy, sensitivity and specificity of MSCC system by using MWT and SVM.

Table 1 MSCC system accuracy, sensitivity and specificity using MWT and SVM

MWT Decomposition	Performance of SVM Classifier		
	Accuracy (%)	Sensitivity (%)	Specificity (%)
1	70.00	60.00	80.00
2	79.00	70.00	88.00
3	88.50	85.00	92.00
4	90.00	85.00	95.00

From table 1 it is observed that highest accuracy of 90 % is obtained at the 4th level of decomposition and its sensitivity and specificity are 85% and 95%. The lowest classification accuracy is 70% obtained at the 1st level of decomposition by using MWT and SVM classifier. Figure 3 shows the graphical representation of MSCC system performance.

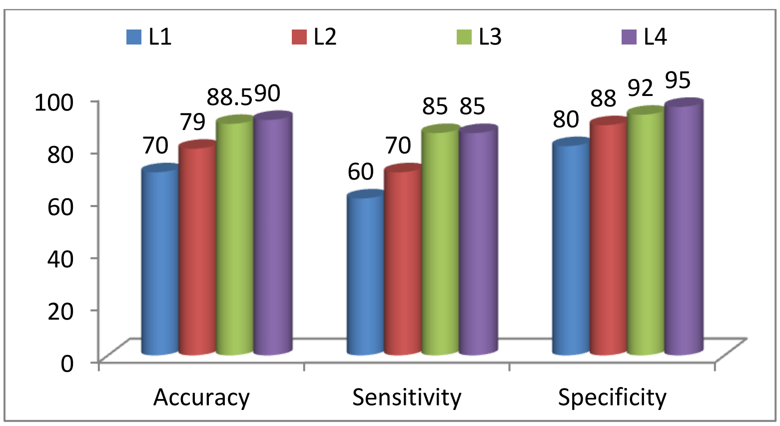

Figure 3 Graphical representation of MSCC system performance

4 Conclusion:

An efficient method for MSCC system using MWT and SVM is discussed in this study. Initially, the input melanoma images are preprocessed by using wiener filter. Then the preprocessed image is given to MWT for decomposition and also it produces subband coefficients. The subband coefficients are extracted by mean, standard deviation and variance.

These extracted features are classified by SVM classifier. PH2 database is used for performance of MSCC system. The MSCC system produces classification accuracy of 90 % using MWT and SVM classifier.

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