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Detection of Skin Cancer Using SVM

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Abstract - *Detection of skin cancer in the earlier stage is very Important and critical. In recent days, skin cancer is seen as one of the most Hazardous form of the Cancers found in Humans.. The detection of Melanoma cancer in early stage can be helpful to cure it. Computer vision can play important role in Medical Image Diagnosis and it has been proved by many existing systems. Skin cancer is found in various types such as Melanoma, Basal, Squamous cell Carcinoma, among which Melanoma is the most unpredictable. In this paper, we present a method for the detection of Melanoma Skin Cancer using Image processing tools. The input to the system is the skin lesion image and then by applying image processing techniques, it analyses to conclude about the presence of skin cancer. The Lesion Image analysis tools checks for the various Melanoma parameters, Color, Area perimeter, diameter etc by texture, size and shape analysis for image segmentation and feature stages. The extracted feature parameters are used to classify the image as Non Melanoma and Melanoma cancer lesion.*

Key Words: Melanoma, eczema, impetigo, LBP histogram, SVM.

1. INTRODUCTION

Skin cancer is defined as the uncontrolled growth of cells in the skin. The malignant tumors are formed due to spreading of skin cells rapidly. Skin cancer can be mainly categorized as three types such as Basal cell carcinoma (BCC), Melanoma, and Squamous cell carcinoma (SCC). The non melanomas were BCC and SCC. The Skin Cancer Foundation (SCF) recently reported that melanoma is the most serious form of skin cancer because it is more likely to spread to other parts of the body. Once melanoma spreads beyond the skin to other parts of the body, it becomes hard to treat. However, early detection saves lives. Research shows that when melanoma is recognized and treated in its early stages, it is nearly 100% curable. According to Indian Cancer Society 2015, it has been reported that the skin cancer rates in India was higher as compared to other countries such as Canada, the US and the UK. It has been reported that nearly 125,693 new cancer cases are spotted but it was higher than 45,395 people are anticipated to death from cancer. Many people got treatment for melanoma but some are dying in the year.

Melanoma is one of the deadly diseases among skin cancer. Melanoma detection can be done by dermatological screening and biopsy tests which are time consuming and expensive that requires experts from medical field. Due to cost of dermatologist to screen every patient, an automated system is needed for melanoma detection so that death rates can be minimized if detected early.

Other skin diseases are eczema and impetigo are also detected in this proposed work. Eczema is one of the most widely known skin diseases, affecting about 10-20% of infants and 3% of adults and children. It is defined by itchiness combined with crusting, scaling and lichenification of skin often in reddish patches. Impetigo is a highly contagious skin condition. It usually occurs on the face, neck, and hands of young children and infants. Children who wear diapers also tend to get it around the diaper area.

1.1 PROPOSED WORK

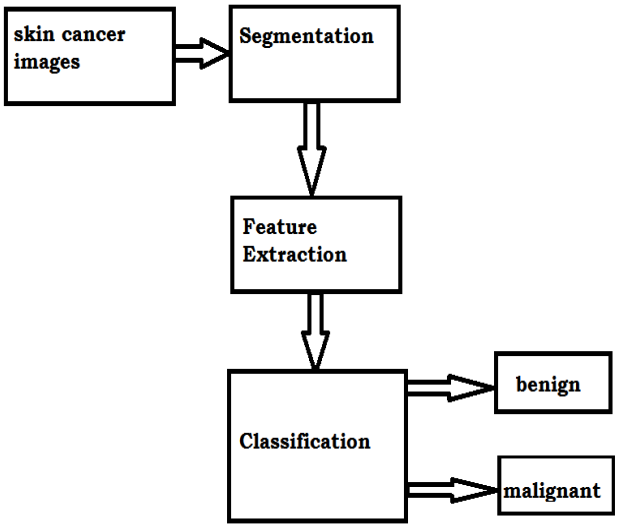

Fig -1: Block diagram of proposed work.

The block diagram of proposed work is as shown in fig-1 which has segmentation, feature extraction and classification process with suitable algorithms. The skin

cancer images are first segmented, then from the segmented images features are extracted using LBP algorithm and classification is done using support vector machine classifier based along the features extracted.

2. SEGMENTATION

The first aim of this paper is to build an efficient robust automatic segmentation tool for skin cancer images. It can be noticed that the lesions have large variations in size as well as in color and contrast to the surrounding skin. Gray-scale morphology is used to derive the segmentation in order to not to lose any important structures or information within the lesion. Active-contours methods have been used to segment pigmented skin Lesion images. However, usually a conversion of a color image to a gray scale image precedes the processing stages.

An active contour model is a technique for contour extraction based on the principle of minimization of the energy defined on a closed curve comprising control points. Active contour model, it is also called as Snakes, has been used. It extracts object at a high contrast against a background and for distinguishing smooth forms. In case of variations in a mass, it is not easy to recognize the size, form, and position of the target, and in such cases, even if it is not desirable, the initial contour must be set up manually. The primary condition for Snake is the initialization of the contour. Snake is used for semi-automatic image interpretation. So, when no automatic starting mechanism exists, Active contour model can be used there. The fig 2 shows the masked output and the segmented image is shown in Fig 3. This model can be used to solve many image processing problems such as detection of edges, lines, and contours. By providing appropriate energy it is possible that to push the initial contour to the desired solution.

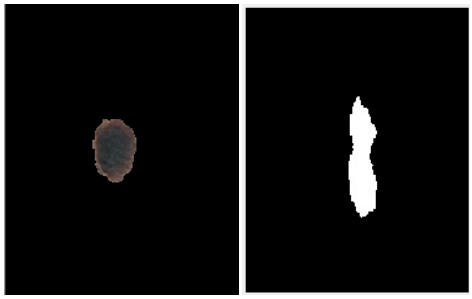

Fig -2: masked output **Fig-3:** segmented image

3. FEATURE EXTRACTION

The aim of the feature extraction method is to extract biologically meaningful features of the melanoma, eczema, impetigo, region that can aid in identification and evaluation.

3.1. Color

The color of the skin differs over the various shades of brown, black, red, white or green. The value is assigned on the presence of each color in the image.

3.2. Major Axis Length or Greatest Diameter (GD)

The length of the line passing through lesion centroid and connecting the two farthest boundary points.

$$(x_c, y_{c)} = (\frac{\sum_{i=1}^{n} x_i}{n}, \frac{\sum_{i=1}^{n} y_i}{n})$$

3.3. Minor Axis Length or Shortest Diameter (SD)

The length of the line passing through lesion blob centroid and connecting the two nearest boundary points.

3.4. Area (A)

Number of pixels of the lesion.

3.5. Perimeter (P)

Number of edge pixels.

3.6. Texture

Image texture gives us information about the spatial arrangement of color or intensities in an image where it may get vary for each pixel or particularly the selected region of an image. To quantify the perceived texture of an image the Texture is used where it is a set of metrics calculated in image processing.

- LBP operator application: LBP are computed for each pixel, creating a fine scale textural description of the image.
- Local feature extraction: Local features are created by computing histograms of LBP over local image regions.

3.6.1. LBP algorithm

The Local Binary Patterns algorithm has its roots in 2D texture analysis. The basic idea of this algorithm is to summarize the local structure in an image by comparing each pixel with its neighborhood. Take a pixel as center and threshold against its neighbors. If the intensity of the center pixel is greater-equal its neighbor, then denote it with 1 and 0 if not end up with a binary number for each pixel. With 8 surrounding pixels will end up with 2^8 possible combinations, which are called Local Binary Patterns or sometimes it is abbreviated as LBP codes.

Table 1: The feature values of melanoma and non melanoma images

Features	Benign	Malignant
Mean(R)	73.20	77.81
Mean(G)	64.47	52.20
Mean(B)	62.21	41.05
Area	1006	2159
Maximal area length	43.21	64.82
Minimal area length	29.85	42.90
Orientation	-89.96	-87.35
Perimeter	115.634	185.48

The feature values of melanoma and non melanoma images are shown in table 1. Based on the lesion of the image the features are extracted.

Firstly, we are converting the input color image to grayscale, since LBP works on grayscale images. For each pixel in the grayscale image, a neighborhood is selected around the current pixel and then we calculate the LBP value for the pixel using the neighborhood. After calculating the LBP value of the current pixel, we update the corresponding pixel location in the LBP mask (It is of same height and width as the input image.) with the LBP value. The LBP histogram is shown in fig 4.

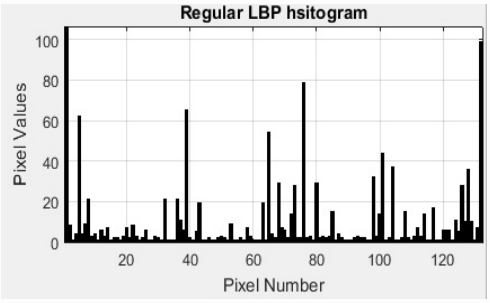

Fig -4 LBP histogram

To calculate the LBP value for a pixel in the gray scale image, we are comparing the central pixel value with the neighboring pixel values. We can start from any neighboring pixel and then transverse either in clockwise or anti-clockwise direction but should use the same order for all the pixels. Since there are n neighboring pixels – for each pixel, we will perform n comparisons. The results of the comparisons are stored in a n-bit binary array. If the current pixel value is greater or equal to the neighboring pixel value, the corresponding bit in the binary array is set to 1 else if the current pixel value is less than the neighboring pixel value, the corresponding bit in the binary array is set to 0.

4. CLASSIFICATION

The support vector machine (SVM) training is used for the optimization of a classification cost. The important advantage of SVM is that they provide a unified framework in which different learning machine architectures can be generated through an appropriate choice of kernel. Statistical and structural risk minimization is the principle used in SVM which minimizes the upper bound on the generalization error.

After the feature extraction process, the extracted features are directly applied to the classifiers, the machine learning tools, for classification into two different classes. The process involves two phases namely training phase and testing phase.

- Training phase: The patterns in terms of features and class labels of benign and malignant images are fed to the classifiers for training.
- Testing phase: Unknown test pattern is fed and the knowledge gained during the training phase will classify the unknown pattern.

The SVM classifier are applied on the statistical texture features to predict the malignancy of the skin lesion. Each skin image in test set is classified by comparing it against the skin images in the training set. The training set consists of both normal and cancer skin images and skin disease images. The comparison is performed using the local features obtained in the previous step. SVMs have several advantages over the more classical classifiers such as decision trees and neural networks.

The most popular used kernel function is Radial Basis Function (RBF). It is given by: $k(x,x') = \exp\left[\frac{-||x-x'||^2}{\sigma^2}\right]$ where σ is a positive real number.
The SVM classifier updates its weights according to the training set and analyzes on the testing set. For the experimental sake, k folds cross validation applied to evaluate the performance of classifier under investigation. The parameter k varied from one to ten means random allotment of training and test images performed such that test set varied from 1 to10 and remained ones considered as training dataset.

To project up nonlinear data to linear data in high dimensional space the Gaussian Radial Basis Function (RBF) kernel is used. The box constraint parameter C for soft margin remains an integral part of the whole experimental process. To investigate and analyze the performance of SVM classifier, three important parameters varied in this way:
• k for cross-validation varies from one to ten with a unit sampling instances.

• C for soft margin varies from 0.1 to 5 at sampling instance of .1 units.
• Sigma, standard deviation of RBF kernel is varied from one to eleven with unit sampling instances.

After learning the SVM using training data with above defined parameters and classification carried on the test dataset defined by k fold cross validation method. The Classification outputs are as shown in figure 5, 6, for both Non melanoma and melanoma images.

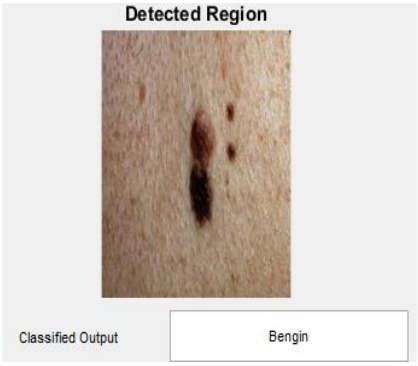

Fig-5: classified output as benign

Fig -6: classified output as malignant

5. CONCLUSION

The proposed work shows the improvement in identifying the melanoma skin cancer at different stages using image processing techniques based on active contour segmentation, Local binary Pattern and SVM classifier. The prime concern of the proposed work is to extract the skin image features i.e. area, perimeter and mean (R), mean (G), mean (B) and texture features. This enables in analyzing the melanoma spot analysis and guides for the direction of spread of the cancer. The features are normalized with respect to skin image size so that the features remain same if the image is varied in respect of it attributes. The main purpose is that the features should not vary for the same image at different orientation, size and location.

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