Skin Disease Detection and Data Compression Using Image Processing

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Abstract- *In our day to day life, skin diseases are spreading faster and sometimes becomes more dangerous and cancerous. Most of the skin diseases cause illness compared with other diseases that cause significant mortality which is caused by bacteria, fungus, viruses or parasites. It has dangerous effects on the skin and keeps on spreading over time so it becomes important to identify these diseases at their initial stage to control it from spreading. Even some types of skin diseases leads to death. Skin diseases are identified by many technologies. In this paper we are using image processing techniques like preprocessing, segmentation, feature extraction and classification through this the user can identify whether the skin is affected or not. Finally the resulted data are compressed and stored using Set Partitioning in Hierarchical Trees (SPIHT).*

Keywords- Hair Detection and Exclusion, Lesion Segmentation, Feature Extraction, Classification and Compression.

I. INTRODUCTION

elanoma is one of the most crucial form of skin cancer, with an estimated 76690 people being diagnosed with melanoma and 9480 people dying of melanoma in the United States in 2013, If melanoma is detected early, while it is classified at Stage I, the 5-year survival rate is 96%[1]. Melanoma affected skin lesions can be identified in the first sight by the careful observation of changes in shape, size, color, texture etc of the skin. The skin lesion can be classified into three as benign, atypical and melanoma. A benign skin lesion is a normal skin, atypical skin lesion may or may not be cancerous and melanoma is a cancerous skin lesion [2].

The two important reasons which demands for an early diagnosis of melanoma are localization of melanoma is superficial (skin) in the majority of the cases hence the detection process can be simple. Segmentation of medical images is a challenging one, because those images can involve noise, diverse artifacts, limitations and unclear edges. There are various types segmentation methods, for example, the zero crossing, thresholding [3, 4], region-based segmentation [6, 12], watershed algorithms [2, 7, 8] and active contours [3, 11, 13, 14].

When these methods are applied to medical images, they may show difficulties in one way or another. In MBS, we first compute a background (a smooth component), which is to be subtracted from the given image, and then apply a segmentation algorithm to the residue; the background must be computed smooth enough not to alter the desired edges. For an appropriately chosen background, the segmentation algorithm must detect edges more effectively from the residue than from the original image, because the residue looks like an essentially binary image and most of segmentation methods work well for such an image.

In this paper Multimode Background Subtraction (MBS) system is used with following major innovations: Background Model Bank (BMB), model update mechanism, MP-based spatial de-noising of pixel-based probability estimates, fusion of multiple binary masks, and use of multiple color spaces for BS process. The size of medical images is high due to this the compression of medical images are necessary. So that the images can be easily transmitted fast even through lower bandwidth and with high reliability for medical diagnosis at remote locations, therefore storage is less consumed.

Various types of compression techniques are developed. The two types of compression algorithms are lossless algorithms and lossy algorithms. A lossless algorithm reproduces the original exactly. A lossy algorithm does not produce the original image exactly there is a loss of some data. Data loss may be unacceptable in many applications. Lossless compression is very common step in many image processing applications, especially in which image is the subject to further processing. Those applications include medical imaging Such transforms are invertible in finite precision arithmetic and map integer to integer and are extremely useful for compression systems requiring efficient handling of lossless coding, faster execution and low memory usage.

SPIHT is considered to be one of the most popular wavelet image compression algorithms. In this paper we propose a modification to the conventional SPIHT in order to enhance the lossless coding performance. This improvement concern the treatment sets of type A by adding a new test on them for testing their signification, and also another test is introduced that operating on the threshold. A key contribution of this paper is the establishment of acceptable reversible compression in the ratio (3:1).

II. LITERATURE SURVEY

There are several classification methods have been introduced and all those methods had used an different algorithms for classification and also the accuracy and load of those existing methods vary with each other. The proposed methods are used to extract the features from the image and to classify the cancer from the given predefined sets. Omar Abuzaghleh et al [1] proposed smart mobile devices based non invasive, real-time system to help in the skin cancer detection.

The system has two main components. First a real-time alert is used to prevent skin burn caused by sunlight. Second an overall analysis of the image system in which contains capturing of image, hair detection and exclusion, lesion segmentation, feature extraction, and classification is used. The captured images of skin lesions can be given to a image processing module which will categorize the skin lesion as benign atypical or melanoma.

For the classification and testing purpose the PH2 database of Pedro Hispano hospital has been used. Three types of SVM classifier has been used by the system for the efficient classification of skin lesion. An improved accuracy for the image classification has been obtained. Karagyris et al has been worked on an image processing mobile application for monitoring skin cancer [2].

The system consists of two components: (i) a small device that attached to the mobile phone for capturing images, (ii) an image processing application that helps to identify the presence of melanoma on skin images. Open CV has been used for the implementation of image processing application. Support vector machines (SVMs) are used for the accurate classification of skin images into normal cases and abnormal cases. The main problem with the system is that the image database was small.

The algorithm identified five from six normal cases as normal ones and all six abnormal cases as abnormal ones. In [3] author proposes a robust part based hand gesture recognition system utilizing Kinect sensor. To handle the hand shapes segmentation drawbacks and obtained the noisy shapes from the Kinect sensor, a novel distance metric are used such as Finger-Earth Mover's Distance (FEMD) which is used find the dissimilarity measures between hand shapes. This process only matches the parts of fingers while not the full hand and it can shows the promising results in term of distinguish the different types of hand gestures.

In [7] author proposes a real time and novel system for interaction with video or application through hand gesture system. In this system it contains two things tracking and detecting of bare hand in cluttered background utilizing hand posture contour comparison algorithm and skin detection after face subtraction, recognizing hand gestures via multiclass Support Vector Machine (SVM) and big-of-features and building a grammar that creates commends of gesture for application control.

Scale Invariance Feature Transform (SIFT) is used for extracting the key points and map key points from every training image using vector quantization technique, after this process K-means clustering applied.

Here histograms are given as input to the SVM during training process and the detected hand gesture points are fed into the cluster model and then it is mapped to the bag-of-words vectors. Then these final outputs are fed into the multiclass SVM classifiers for further hand gesture recognition.

For the compression of medical images, the 3D SPIHT algorithm has achieved good performance and many variants have been developed to meet different goals. Pearlman et al. [8, 9] used stripe-based SPIHT for volumetric medical data compression providing low memory and uniform reconstruction quality. Beladgham et al. [10] applied lattice structure to improve the performance of the quincunx wavelets-based SPIHT algorithm.

III. PROBLEM DEFINITION

Hair detection and exclusion is an important step in the skin cancer image analysis system. The presence of hair on skin lesion will make an obstruction for effective lesion segmentation and feature extraction. And that will leads to an inaccurate classification result of the system. So if it is possible to remove the hair from the lesion it will be an advantage for effectiveness of the system. The method used for hair detection and exclusion in previous work was based on 2D-Derivative of Gaussian and Exemplar-based in painting. The system performance can be increased if a better technique is used.

IV. PROPOSED SYSTEM

In the proposed system a new method has been implemented for the effective hair detection and removal. The method is based on 2D-Derivative of Gaussian and fast marching In-painting algorithm. By the careful observation of changes in shape, size, texture, color etc of skin, it's possible to decide whether the skin lesion has to be tested for detection of skin cancer.

The implementation of this software will lead to early detection of melanoma and according to the test result the person can go for further medical diagnosis and treatments. For the development of the system Matlab is used.

In the proposed system the user can capture the image of suspected skin region by using a smart phone with better picture quality. By using the various image processing techniques like hair extraction, segmentation, feature extraction and classification the user can make the confirmation whether the skin is malignant or not.

The entire process can be concluded to the following steps:

1) Hair Detection
2) Lesion Segmentation
3) Feature Extraction
4) Classification
5) Compression

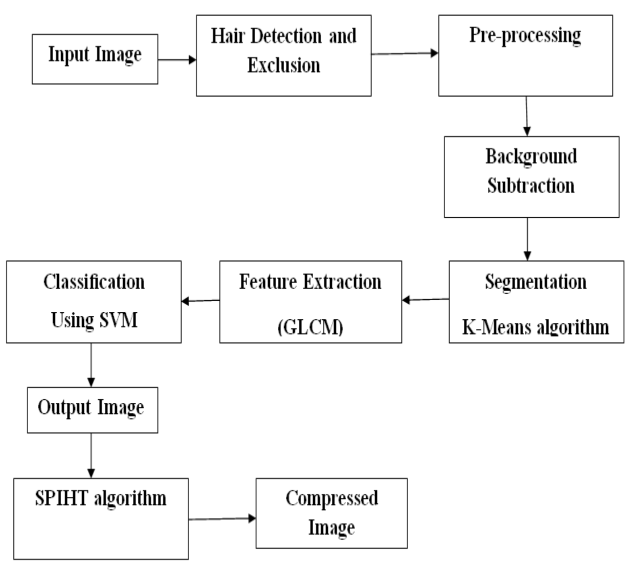


Figure 1: Architecture of the proposed system

Figure 1 shows the architecture of the proposed system. The system will test skin lesion and inform the user whether it is a benign, atypical or melanoma lesion. First the input image is given to a hair detection and extraction module. Some pre-processing steps are applied prior to the segmentation. Segmented image is used for the feature extraction. The extracted features are used for the classification.

A. Hair Detection and Exclusion

The presence of hair on skin lesion will make an obstruction for effective lesion segmentation and feature extraction [6]. To detect the presence of hair, first the image is applied to a matched filter with first order derivative of Gaussian (MFFDOG) after converting the RGB image into grayscale. After that a thresholding [7] scheme is used to detect hair-occluded information compared to non-hair objects.

Morphological edge based techniques, CC-Labeling algorithm and area opening operations are used for the refinement of hairs. The hair mask obtained from Rough detection and refinement of hairs is put onto the input image in RGB color space. Finally a fast marching in-painting algorithm is used to restore the wound and remove the hairs [6].

The main advantages of using fast marching algorithm are its robustness, parameter less and non-iterative nature and it can maintain the skin lesion without affecting the texture properties even after the removal of hairs. The following algorithm is well explained the hair detection and exclusion procedure. The following images well explained the hair detection and exclusion part.

B. Image Segmentation

An unrestrained growth of tissues in any part of the body is called as tumor and different types of tumors are available and each differs from its size and characteristics. Generally, melanoma images are taken by normal photograph and are needed to be well examined by physicians for diagnosing purposes. However the above method of detection resists the accuracy of determination of stage & size of tumor. In order to avoid the lack in accuracy, it is possible to propose a segmentation algorithm called K-means clustering algorithm.

K-Means algorithm is the unsupervised learning algorithm for clusters. According to the above said algorithm, the pixels are grouped or clustered to form an image. The number of clusters 'k' to be defined at initial process of k-means clustering algorithm. The center 'k' is chosen randomly. Once the k- cluster center is defined, a distance is calculated between pixels and cluster centers of each. A simple Euclidean function has been used for distance calculation. Using distance formula each pixels are compared with all cluster centers. The shortest distance has been calculated using distance formula, based on the shortest distance among all the pixels are moved to a particular cluster. Centroid is estimated once again and again each pixel is compared to all re-estimated centroids. Until the center converges, the above process is continued. Otsu's thresholding method [7] is used to convert a grayscale image to a binary image. Step 3 of Figure 2 shows the thresholded image.

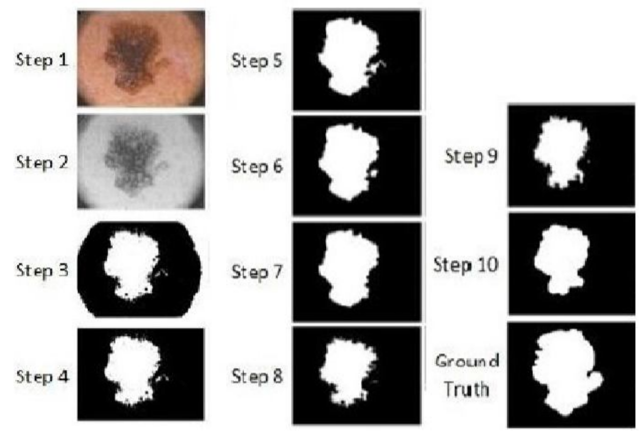


Figure 2: Steps of the image pre-processing and segmentation algorithm applied to an input image

In this thresholding method it assumed that the image should contains two classes of pixels which follows the bi-modal histogram (foreground pixels and background pixels), then it calculates the optimum threshold separating the two classes so that their combined spread is minimal so that their inter-class variance is maximal.

C. Feature Extraction

The accuracy and efficiency of the proposed system is based on extracted features from the skin cancer image. Texture and color features are the two main categorized features from extracted images. Autocorrelation, Contrast, maximum probability, sum of squares, sum average, sum variance etc., are the main features which are extracted with the help of Gray level co-occurrence (GLCM) matrix from the skin cancer image. With the help of GLCM there are some distinguished features that separate each class of skin cancers.
Eminent features of each class of skin cancerous are extracted with the help of feature extraction algorithm. Those extracted features are used for processing. Gray level co-occurrence matrix is the proposed feature extraction technique. The acquired image converted from RGB to gray level, gray level is highly good for feature extraction using GLCM feature extraction technique.

The pixel values of gray converted image are given to the GLCM matrix as an input, where the columns and rows of GLCM matrix are equal to the total number of pixels in the gray level image.

GLCM computes the frequency values for each pixels of the gray converted skin cancer image. The computed values from GLCM matrix are called as features or predictors. These extracted features are mapped with different angular positions by spatial relationship of different combination of pixels. Table 1 shows the list of features extracted.

Features	Explanation
Energy	Measure the homogeneousness of the image.
Entropy	Measure of complexity of the image
Contrast	Measure of the local variations and texture of shadow depth
Homogeneity	Measure of closeness of the distribution of elements
Cross Correlation	Degree of joint probability occurrence of the specified pixel pairs.

Table.1 List of main features extracted

D. Classification

Lesion classification is used as an important step in the melanoma detection. The classification stage takes the input from the feature extraction module. The values calculated from the feature extraction module are used as a criterion for the training and testing of images in the classification. SVM classifier is used for the classification of skin images [10]. A block diagram of the two-level classifier is shown in Figure 3. In the first level the images are classified either into benign type or abnormal type. In the second level the images from the Abnormal are classified as atypical or melanoma.

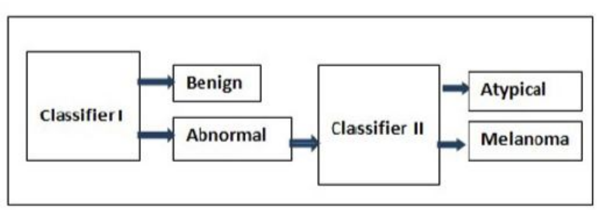


Figure 3: Proposed framework for image classification

E. Compression

SPIHT (Set Partition in Hierarchical Trees) [1] algorithm is one of the most advanced one, even outperforming the state-of the art JPEG 2000 in some situations. The basic principle of this algorithm in the area of image compression is the Set Partitioning in Hierarchical Trees (SPIHT).

Overlapping windows are used by Daubechies wavelets, so the high frequency coefficient spectrum reflects all high frequency changes. Therefore Daubechies wavelets are also useful in compression as well as in noise removal of audio signal processing [5].

The implementation of medical image compression algorithm includes following steps:-

1. The medical image is given as input and then image is divided into ROI (Region of Interest) and NROI (Non – Region of Interest) i.e. the region is infected and to be diagnose that regions. The Region of Interest may change according to the medical studies. In Non-Region of Interest the regions being not infected by any disease other than the ROI region or the background image and without any diagnostic value. The ROI having high priority means bit stream generated for this ROI will be appeared early in the whole image bit stream. The background area usually has lowest priority that is appeared in final part of whole image bit stream.

2. After choosing the corresponding ROI's and NROI's portion, we compress the ROI portion with lossless method i.e. SPIHT algorithm. SPIHT algorithm provides a good quality of image for maintaining diagnostic importance and compress the NROI portion with lossy method i.e. DB Wavelet transform is used to achieve high compression ratio for efficient storage and high speed transfer even in low bandwidth.

3. Now, in order reconstruct the original image the decompression is done on ROI part and NROI part by their respective inverse algorithms and integration of bits. Then the compressed image is decompressed and viewed with same quality.

Usually the quality of image is measured in terms of PSNR and MSE. In order to get good quality image, the PSNR value should be as high as possible & the MSE value should be as low as possible. It has been observed that PSNR is not always an indicator of the subjective quality of the reconstructed image, so that we can use MSE (Mean Square Error). PSNR (Peak Signal to Noise Ratio), SSIM (Structural Similarity Index) and Entropy as an objective quality measures.

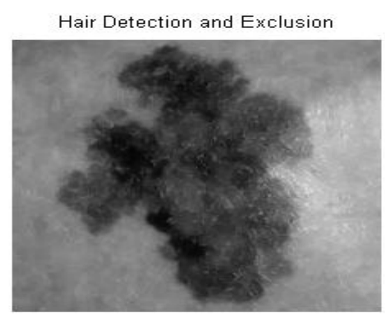
V. RESULTS AND DISCUSSION

Skin Disease detection using various advanced techniques which is proposed in this was tested on various diseases infected image samples. It produces accurate results with an accuracy of 97%.

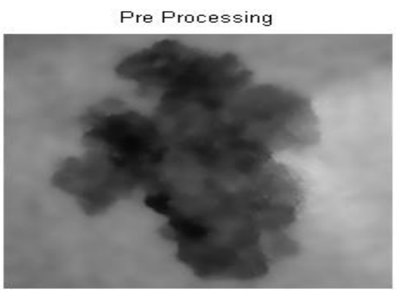
At the output it shows the Images after passing each stage, it displays the type of disease is affected and what is the stage of that disease, causes of that disease and symptoms of that disease to create an awareness for the user.

Finally the image is compressed and stored for further documentation. The entire result is shown in the figures.

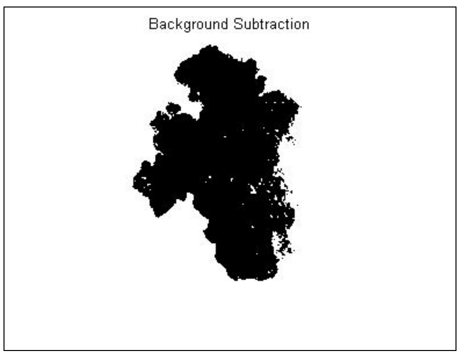
(a)



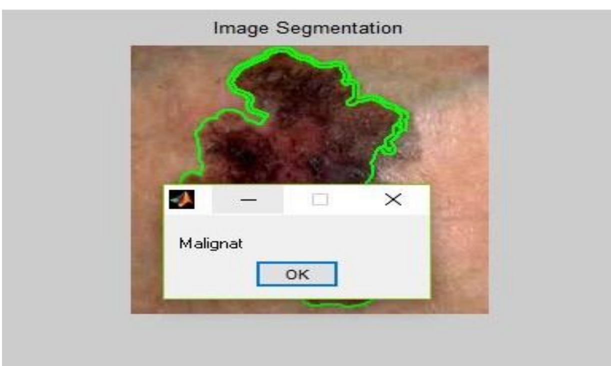
(b)



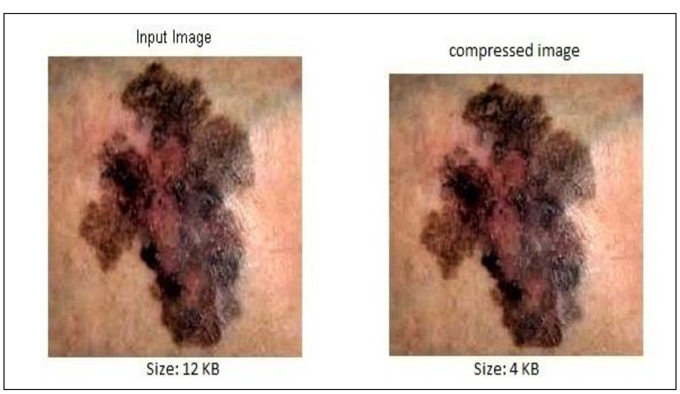
(c)



(d)



(e)



(f)

Figure 4: (a) Input image given by the user, (b) Hair is detected and excluded, (c) Image is preprocessed, (d) Background is subtracted, (e) Image is segmented and disease is identified, (f) Image is compressed and stored.

The system which is proposed here produces results with more efficiency and reduced complexity and also integrates various processes in a single one.

VI. SUMMARY AND CONCLUSION

This paper presented a new system for the detection of skin cancer. It well explained the major steps to help in the melanoma detection. The main component is an image processing module that effectively classifier the moles into benign, atypical or melanoma. In this proposed system automatic image analysis process is carried out that includes hair detection and exclusion, lesion segmentation, feature extraction, classification and compression.

The main feature that highlights this work is the hair detection and exclusion part. The matched filtering with first order derivative of Gaussian and fast marching in-painting algorithm makes the hair exclusion part a better one. It helps all other stage to perform efficiently. Since six different types of features are used, the training and testing part of the classification stage become simpler. The proposed system is able to classify the images into benign, atypical and melanoma with high accuracy.

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