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ANALYSIS OF SKIN CANCER USING ABCD TECHNIQUE

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Abstract - *Melanoma is a type of skin cancer which arises on the outer layer of skin. Major cause of this type of skin cancer is over exposure of skin to UV radiation and also severe sun burns. It has higher chances of death. There are many clinical diagnosis techniques are available, but the exact and accurate results of melanoma is acquired by analyzing of skin lesion image with the emerging image processing. In this paper, an ABCD technique is proposed to detect the melanoma skin cancer. This study narrates the procedure and methodologies of image processing and soft computing techniques used to diagnose the melanoma with better accuracy.*

Key Words: Skin lesion image, Total Dermoscopic Score, Malignant Melanom, ABCD parameter

1. INTRODUCTION

In humans, skin is the largest organ of the integumentary system. The skin guards the underlying muscles, bones, ligaments and internal organs. Skin plays an important immunity role in protecting the body against pathogens and excessive water loss. Severely damaged skin will try to heal by forming scar tissue. This is often discoloured and depigmented. Skin is composed of three primary layers: the epidermis, the dermis and the hypodermis. In the epidermis layer, there exist melanocytes which are cells that contain melanin, and it is the melanin which gives colour to the skin. Cancer can be of two types, benign or malignant. Benign tumors aren't cancerous. In most cases, they do not come back. Cells in benign tumors do not spread to other parts of the body. Malignant tumors are cancerous and are made up of cells that grow out of control. Cells in these tumors can invade nearby tissues and spread to other parts of the body.

Malignant Melanoma is the leading cause of death nowadays. The incidence of melanoma has doubled during the last 20 years. This cancer is most often caused by ultraviolet radiation from the sun which causes unrepaired DNA damage to skin cells which further develops into cancerous tumours. If melanoma is recognised in the early stages it is proven to be curable. If not, the cancer advances and spreads to all other parts of the body and becomes incurable leading to death. It is estimated 76,690 people being diagnosed with melanoma and 9480 people dying of melanoma in the United States in 2013. In the United States, the lifetime risk of getting melanoma is 1 in 49. Melanoma accounts for approximately 75% of deaths associated with skin cancer. Recent trends found that incidence rates for non-Hispanic white males and females were increasing at an annual rate of approximately 3%. If melanoma is detected early, while it is classified at Stage I, the 5-year survival rate is 96%; however, the 5-year survival rate decreases to 5% if the melanoma is in Stage IV.

In this paper, an ABCD technique is proposed to detect the malignant melanoma at an early stage in order to reduce the medical cost of taking biopsy. First the skin image is filtered by using wiener filter and then segmented to extract the features by using otsu thesholding and boundary tracing algorithm. The advantage of these methods for image segmentation is to obtain an accurate result for the feature extraction. The histogram of gradient method is used to extract the features of segmented image and then ABCD technique is applied to differentiate mole and melanoma and also find the spreading chances of melanoma.

2. BACKGROUND

The method on 'various techniques for detecting skin lesion' is an unsupervised algorithm, called the Independent Histogram Pursuit (IHP), for segmenting dermatological lesions is mentioned here. The algorithm estimates a set of linear combinations of image bands that enhance different structures embedded in the image. A texture distinctiveness metric is calculated to measure the dissimilarity of a texture distribution from all other texture distributions. Second, the texture distinctiveness metric is used to classify regions in the image as part of the skin class or lesion class. The iterative stochastic region merging algorithm proposed for skin lesion segmentation includes assigning each pixel in the image to a unique region and these regions are subsequently merged with other regions in a stochastic manner. An approach for CAD is to find the location of lesion and also to determine an estimate of the probability of disease. The typical architecture of CAD system includes selection of training samples, image pre-processing, segmentation, feature extraction and classification. The proposed segmentation technique is K-means clustering algorithm. After that ABCD rule is used for diagnosis of lesion. An automatic melanoma detection using Dermoscopic images was implemented using MATLAB code [4]. Finally the Total Dermoscopic Score (TDS) is calculated based on which if the cancer is melanoma or not is decided. In the method of 'feature extraction on skin lesion detection' has mainly two phases to detect the melanoma. First phase is Otsu's segmentation method which is fully unsupervised and requires no changes in the skin parameters. Second phase is Feature Extraction which defines the basis of diagnosis of disease. There are three diagnoses i.e. Melanoma, Suspicious and Benign. Feature extraction is done using the ABCD rule of dermatoscopy. The decision of diagnosis is based on the value of TDV. A method on 'skin cancer detection and feature extraction based on clustering techniques' in which detection of Melanoma Skin Cancer using Image Processing tools. The Lesion Image analysis tools checks for the various Melanoma parameters Like Asymmetry, Border, Colour, Diameter,(ABCD) etc., by texture, size and shape analysis for image segmentation and feature stages. The extracted

feature parameters are used to classify the image as Normal skin and Melanoma cancer lesion [6]. Approaches to detect the melanoma skin cancer and feature extraction through various image processing techniques are Otsu thresholding and boundary tracing.

The important steps in a diagnosis of melanoma skin cancer are: image acquision of lesion image, Segmentation of the lesion area from the outer area, Extraction of the feature from the input image. Based on the extraction, the classification has to be done. Feature extraction is the intent of extracting the features from the lesion image in order to characterize the melanoma. But all melanomas do not have all four ABCD features. It is the combination of features (e.g., A+B, A+C, B+C, A+B+C, etc.) that render some lesions most suspicious for early melanoma.

3. PROPOSED METHOD

The Fig-1 shows the analysis of malignant melanoma using ABCD technique, the initial step is pre processing where the noise is filtered from the original image. It involves the median filter and Wiener filter, the effectiveness of the filter is gained by calculating peak signal noise ratio (PSNR) and mean square error (MSE). The next step is segmentation where the cropping of lesion takes place. The essential step is feature extraction where the ABCD technique is applied. Then identification of malignant melanoma takes place based on parameters of feature extraction. The following section of this chapter will discuss in detail about the proposed method.

3.1 Image acquisition

The first step in detecting skin cancer is the detection of melanoma and in computer aided diagnostic system. It involves acquisition of the digital image of affected skin. Dermoscopy involves an evaluation of the skin surface. During a dermoscopy assessment, the pigmented skin lesion is covered with a liquid (usually oil or alcohol) and examined under a specific optical system. Applying oil reduces the reflectivity of the skin and enhances the transparency of the stratum corneum. This allows visualization of specific structures related to the epidermis, the dermo-epidermal junction, and the papillary dermis, and it also suggests the location and distribution of melanin. Image acquired from dermatoscope is called dermoscopic image.

3.2 Preprocessing

The main goal of pre-processing is to improve the image quality to make ready to further processing by removing or reducing the unrelated and surplus parts in the back ground of the dermoscopic images. The noise and high frequency components removed by filters. Image pre-processing is the term for operations on images at the lowest level of abstraction.

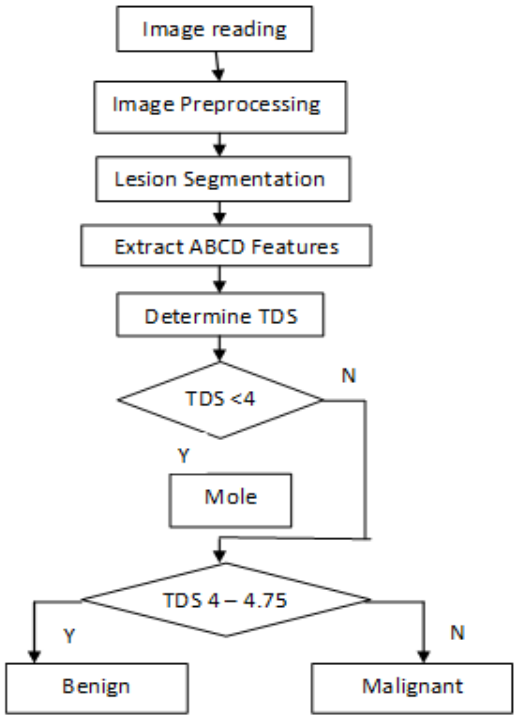


Fig – 1: Flowchart of proposed method

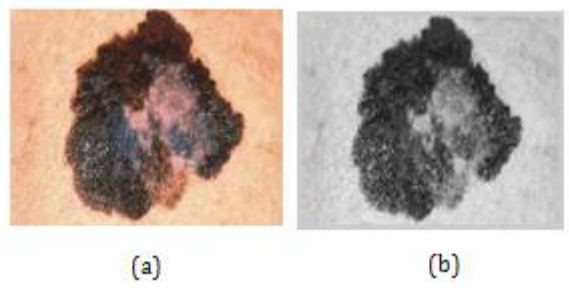
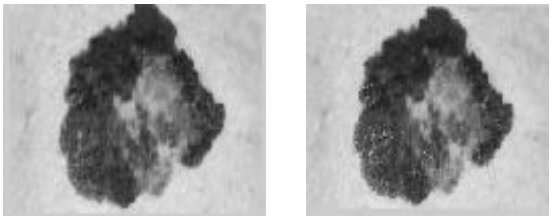


Fig – 2: (a) Original Image (b) Gray Image

These operations do not increase image information content but they decrease it if entropy is an information measure. The aim of pre-processing is an improvement of the image data that suppresses undesired distortions or enhances some image features relevant for further processing and analysis task. Pre-processing uses the redundancy in images, hence there are two types of filter are used namely median and wiener filter.

The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. Wiener filter aims to describe the process of recovering an image, degraded through some digital acquisition process, by applying the Wiener Filter. The image capture devices are not perfect; they may present different types and levels of noise. Wiener Filter works in frequency domain trying to minimize the noise impact when the image is deconvolved. The image may not be completely recovered, but the Wiener Filter give use a good approximation.



(a) (b)

Fig – 3: Preprocessing image using (a) Median filter (b) Wiener filter

The Peak signal to noise ratio (PSNR) for output images provides information about denoising effect. The higher PSNR value gives better denoising effect. Table - 1 shows the average result for the PSNR value of 10 skin images and also indicates that wiener filter is better for filtering the noise.

Table – 1: Average PSNR value of images

FILTER	PSNR (dB)
Median filter	27.9726
Wiener filter	30.9940

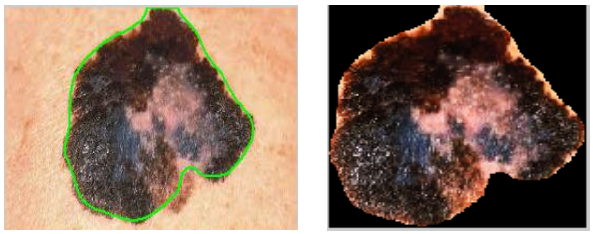
3.3 Segmentation

The next step is to segment the lesion area from the input image. It is performed to separate the ROI from the background. Image after processing contains cancerous region and healthy skin only. The ROI is the cancerous region. It has to be separated from the background skin. For this intent the image segmentation has been done.

In this paper, Otsu thresholding and boundary tracing algorithms are used one after another in order of clear segmentation of the lesion area from other part of the image. Thresholding provides an easy and convenient way to perform this segmentation on the basis of the different intensities or colors in the foreground and back ground regions of an image.

In Otsu's method the threshold that minimizes the intraclass variance (the variance within the class) is selected by trial and error. Within class variance is defined as a weighted sum of variances of the two classes. Otsu shows that minimizing the intra-class variance is the same as maximizing inter-class variance (between class variance). Otsu's thresholding is Clustering based image segmentation technique or reduction of a gray level image to a binary image. This algorithm assumes that the image to be threshold has two classes of pixels or bi-modal histogram (foreground and background pixels) and then it calculates the optimum threshold that separates those two classes in such a way that it has minimum variance. In Otsu's method the threshold that minimizes the intraclass variance (the variance within the class) is selected by trial and error.

The boundary tracing algorithm is used to extract the contours of the objects (regions) from an image. When applying this algorithm it is used to find edges, this function looks for places in the image where the intensity changes rapidly, using one of these two criteria: Places where the first derivative of the intensity is larger in magnitude than some threshold. Places where the second derivative of the intensity has a zero crossing.



(a) (b)

Fig – 4: Image segmentation (a) Boundary traced (b) Enhanced image

3.4 Feature Extraction

Early detection of lesion is very important and crucial step in the field of skin cancer treatment. There is a great significance if this will be achieved without performing biopsies. This is the simple way to investigate the digital images of skin lesions in order to identify melanoma. Feature extraction is the important tool which can be used to analyze and explore the image properly. The feature extraction is based on the HoG followed by ABCD rule of dermatoscopy. The ABCD stands for Asymmetry, Border structure, Color variation and Diameter of lesion. It defines the basis for diagnosis of disease. The decision of diagnosis is based on the value of Total Dermoscopy Score (TDS) Value.

The essential thought behind the histogram of oriented gradients descriptor is that local object appearance and shape within an image can be described by the distribution of intensity gradients or edge directions. The image is divided into small connected regions called cells, and for the pixels within each cell, a histogram of gradient directions is compiled. The descriptor is the concatenation of these histograms. For improved accuracy, the local histograms can be contrast-normalized by calculating a measure of the intensity across a larger region of the image, called a block, and then using this value to normalize all cells within the block. This normalization results in better invariance to changes in illumination and shadowing.

(i)Asymmetry: Asymmetry Index is computed with the following equation,

$$A_I = (A_1+A_2)/2A_r$$

where, A1= Area of non-overlapped region along minor axis of the lesion, A2= Area of non-overlapped region along major axis of the lesion., Ar= Area of lesion implementation.

Area of lesion (Ar) can be calculated using bw area over the binary image of the segmented region. The segmented region is divided along the lines passing through centroid of the region Two separate areas are generated which are then adjusted so that the areas will be overlapped by flipping one area. To generate area along x axis the bisection will be generated using first Gx pixels and the next Gx pixels along x axis and bisecting line on y axis. To generate area along y axis the bisection will be generated using first Gy pixels and the next Gy pixels along x axis and bisecting line on y axis. After calculating area of the regions, asymmetry index is calculated using the specified formula.

(ii) Border Irregularity: Border structure can be analyzed by calculating Compact Index, Fractal Dimension and Edge Abruptness.

a. Compactness Index: Compact Index is used to measure the most famous form of barriers which estimates unanimous 2D objects. However, along boundary this measure is very sensitive to noise. The value of CI is determined by using below equation:

$$CI = \frac{P^2_L}{4\pi A_L}$$

b. Fractal Dimension: Fractal dimension is an integer value. For line, filed and cube the values is 1, 2 and 3 dimension respectively. However, in case of fractal dimension it may worth fraction. By using Box Counting method, fractal dimension can be calculated and for this Hausdorff dimension method is used. In this method the image is divided into the boxes.

c. Edge Abruptness: Edge abruptness is nothing but irregular boundaries. Lesion with irregular boundaries has large difference in radial distance. The estimation of barrier regularity is done by analyzing the distribution radial distance difference. md is mean distance of d2 between centered point and barrier.

$$C_T = \frac{\frac{1}{R_i}\sum P \in C\,(d_2(p, G_L) - m_d)^2}{m_d^2}$$

d. Pigment Transition: This feature describes the transition of skin pigmentation between the lesion and surrounding skin. Here we calculate the mean and variance of the gradient of pigment transition which describe the transition between the injury and the setting points of skin on each side i.e., level of steepness.

(iii) Color Variation: Color index is calculated by converting the input image to have image value by checking the presence of the following colours. Length of all the available pixels with given values is divided by total number of pixels. The presence of colour is dependent on the value of resultant not equal to zero. For each colour the presence of Colour Index is +1 (Dr. V.Venkatesan et.al, 2016). The emergence of color variation in the color is early sign of melanoma. Because melanoma cells grow in grower pigment, they are often colorful around brown, or black, depending on the production of the melanin pigment at different depth in the skin. The descriptors of color are mainly statistical parameters calculated from different color channels, like average value and standard deviation of the RGB or HSV color channel. Here color variance of the RGB image has been calculated using HSV channel.

ABCD rule is applied for the segmented malignant melanoma image. Asymmetry, border, colour variation, diameter parameters are calculated. The TDS value is calculated is based on the ABCD parameters. TDS value is calculated by using the formula,

TDS= (A*1.3) + (B*0.1) + (C*0.5) + (D*0.5)

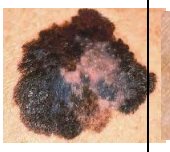
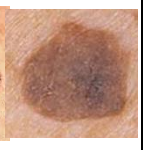
Table- 2: Range of TDS value

TDS Value	Interpretation
0-4	Mole
4 – 4.75	Benign
> 4.75	Malignant melanoma

4. RESULTS AND DISCUSSION

ABCD technique provides differentiation between the normal moles, benign and malignant melanoma and also used to identify malignant melnoma at an early stage without taking biopsy. The results of the technique are given in Table - 3.

Table- 3: Interpretation of skin lesion images based on TDS value

Images / **Parameter**			
Asymmetry	1.23	0.6	0.3
Border	3.21	1.1	0.5
Color	4.02	1.2	0.81
Diameter	4.3	1.8	1.5
TDS value	**12.76**	**4.7**	**3.11**
Inter-pretation	**Malignant melanoma**	**Benign**	**Mole**

The Fig - 4 shows the output report of malignant melanoma and spreading chances of melanoma. It is based on the TDS value calculated identification of malignant melanoma takes place. And further probability of spreading chances also calculated.

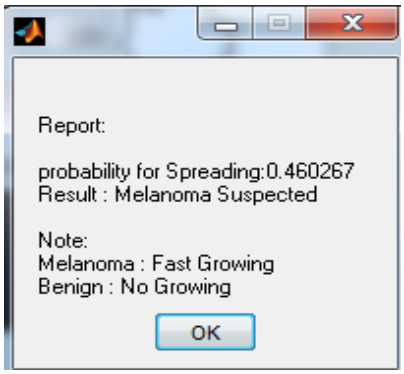


Fig – 5: Output report on malignant melanoma

4. CONCLUSION

Incident rates of melanoma skin cancer have been rising since last two decades. So, early, fast and effective detection of skin cancer is paramount importance. If detected at an early stage, skin has one of the highest cure rates, and the most cases, the treatment is quite simple and involves excision of the lesion. Moreover, at an early stage, skin cancer is very economical to treat, while at a late stage, cancerous lesions usually result in near fatal consequences and extremely high costs associated with the necessary treatments. When a mole is suspected to be a melanoma mole, it must go through all four analyses "ABCD", not just the first which were described. In fact, the classification result is not complete, because only three clinical features of early malignant melanoma are being looked at in this work. A classified "non-melanoma" may be found to be a melanoma tumor after it gone through the size analysis, so size analysis should not be omitted. The above estimated parameters are not enough for the detection of melanoma because different types of melanoma are spreading widely. Hence further findings of minute parameters are required for detection of upcoming skin cancers and skin diseases. After all, the best way to prevent ourselves from getting this disease is to look after ourselves carefully, to stay away from the Sun, and keep our body as healthy as we can. It is better and easier to prevent than to find a cure.

According to research done by the Canadian Dermatology Association, it was found that most skin cancers are preventable. Moreover, understanding ourselves, being observable, and staying alert to pigmented spots on the skin are all good ways to reduce the chance of getting any skin cancer which is a risk to human life.

REFERENCES

[1] Mangesh Patil, Vijay Sansuddi, Shashidhar Kudure, "SMART Real-time Skin Cancer Identification", International journal of software and hardware research in engineering, Vol 2, Issue 6,pp 27-28, ISSN 2347-4890, June 2014.

[2] P.Thangavel, S.Gopinathan, " Image Enhancement System Using Wavelet transform and a Non-Linear piecewise filter", ICGST International Journal on graphics, Vision and Image Processing, GVIP, Vol 11, Issue 2, pp 1-7,(2011).

[3] S.Gopinathan , S.Poornima, "Image Enhancement for Impulse Noise Reduction on Images using various filters", International Journal of Advances in Computer Science and Technology, Vol.4, Issue 4, pp 39-47, ISSN 2320-2602, Apr (2015).

[4] Siddiq Iqbal, Divyashree.J.A, Sophia.M, Mallikarjun Mundas, Vidya.R, "Implementation of Stolz's Algorithm for Melanoma Detection", International Advanced Research Journal in Science, Engineering and Technology, Vol. 2, Issue 6, pp 9-12, ISSN 2393-8021 ISSN 2394-1588, June 2015.

[5] S.Gopinathan, S.Poornima, "Enhancement of Images with Speckle Noise Reduction using different filters", International Journal of Alied Sciences and Engineering Research, Vol 4,Issue 2,pp 190-209, ISSN 2277-9442, (2015).

[6] DR.P.Venkatesan et.al, "Skin Cancer Detection and Feature Extraction through Clustering Technique" , International Journal of Innovative Research in Computer and Communication Engineering Vol. 4, Issue 3, March 2016.

[7] Nishadevi.R and Gunavathi.C , "Segmentation and Risk Identification of Melanoma Skin Lesions Using Boundary Tracing Algorithm" , International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 3 Issue IV, April 2015.

[8] Dr. S.ramesh, " Automatic boundary trace segmentation of skin cancer using glcm based on feature extraction in support vector machine", international journal of advanced research in biology engineering science and technology vol. 2, special issue 10, march 2016.

[9] Neenu Paliwal, "Skin cancer segmentation, detection and classification using hybrid image processing technique" , International Journal of Engineering and Applied Sciences, Volume-3, Issue-4, April 2016.

[10] Nagaoka, T., et al. "Melanoma screening system using hyper spectral imager attached to imagifiberscope." Engineering in Medicine and Biology Society (EMBC),

2012 Annual International Conference of the IEEE, 2012.

[11] Abuzaghleh, Omar, Buket D. Barkana, and Miad Faezipour. "Skin cure: A real time image analysis system to aid in the malignant melanoma prevention and early detection." Image Analysis and Interpretation (SSIAI) Southwest Symposium on IEEE 2014.

[12] Maurya R, Surya K . S , Maurya K .A and Ajeet ," GLCM and Multi Class Support Vector Machine based Automated Skin Cancer Classification, "IEEE journal, vol 12 ,Apr. 2014.

[13] Jeffrey Glaister, Alexander Wong and David A. Clausi "Segmentation of skin lesions from digital images using joint statistical texture distinctiveness"0018- 9294 IEEE Transactions on Biomedical Engineering, 2013.

[14] Aswin R.B, J. Abdul Jaleel, Sibi Salim, "Hybrid Genetic Algorithm Artificial Neural Classifier for Skin Cancer Detection" IEEE 2014 Ms. H. R. Mhaske, Mrs. D. A. Phalke, "Melanoma Skin Cancer Detection and Classification Based On Supervised and Unsupervised Learning", IEEE 2013.

[15] J Abdul Jaleel, Sibi Salim, Aswin.R.B "Computer Aided Detection of Skin Cancer", IEEE 2013.

[16] Harpreet Kaur, Aashdeep Singh, "A Review on Automatic Diagnosis of Skin Lesion Based on the ABCD Rule & Thresholding Method," International Journal of Advanced Research in Computer Science and Software Engineering Research Paper, Vol 5, Issue 5, pp 326-331, ISSN 2277 128X, May 2015.

[17] Brian D' Alessandro and Atam P. Dhawan "3-D Volume Reconstruction of Skin Lesions for Melanin and Blood Volume Estimation and Lesion Severity Analysis" IEEE Transactions on Medical Imaging, Volume 31, No. 11, November 2012.

[18] Alexander Wong, Jacob Scharcanski and Paul Fieguth "Automatic Skin Lesion Segmentation via Iterative Stochastic Region Merging" IEEE Transactions on Information Technology in Biomedicine, Vol. 15, No.6.