Cutaneous Melanoma Skin Cancer Analysis Using Threshold Image Segmentation Techniques

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***Abstract*- Medical image processing is one of the most difficult subfields in the dynamic field of image processing research. The internal parts of the human body are imaged using medical imaging techniques in order to aid in diagnosis. Uncontrolled proliferation of abnormal skin cells is known as skin cancer, one of the most serious skin illnesses. Sunshine's UV radiation is the cause of it. The most dangerous kind of skin cancer is cutaneous melanoma. The suggested method uses image processing techniques to diagnose Cutaneous Melanoma Skin Cancer. The analysis of digital lesion images has been conducted using several techniques such as image acquisition, pre-processing, and segmentation. The impacted area of the input skin image is extracted using the image segmentation technique. After the skin lesion region is extracted the ABCD (Asymmetry, Border, Color and Diameter) features and TDS (Total Dermatoscope Value) are calculated. The experimental results are evaluated and the Cutaneous Melanoma Skin Cancer is diagnosed based on the TDS values of the image.**

***Index Terms*- Cutaneous Melanoma Skin Cancer, Image Acquisition, Image Pre-Processing, Image Segmentation, ABCD Rule, Cutaneous Melanoma Skin Cancer Detection.**

1. INTRODUCTION

The Cutaneous Melanoma is the most dangerous type of skin cancer in the medical filed, and it is an uncontrolled growth of abnormal skin cells caused by DNA damage resulting due to the ultraviolet radiation from sunshine. The sign of skin cancer often starts as the change of color in the skin and they are usually in mixed color (pink, red and brown). There are three types of skin cancers: Basel cell cancer, squamous cell carcinoma and malignant melanoma. The first two types do not spread quickly, but the third one spreads quickly.

Cutaneous Melanoma is much less common than basal cell and squamous cell skin cancer, but it is more dangerous than the other two types. However, it is much more dangerous if it is not found early. It causes the majority (75%) of deaths related to the skin cancer [1].

The most sign of cutaneous melanoma is the appearance of a new mole or a change in an existing mole. The changes may be in size, shape, or color. Cutaneous melanoma is common for men and women. In women, the most common site is the legs and cutaneous melanomas in men are most common on the back. It is particularly common among Caucasians, especially northern Europeans liv ing in sunny climates. The risk of cutaneous melanoma is to limit the exposure to strong sunlight and other source of Ultraviolet light. Tanning beds emit UV rays and the younger people who regularly use tanning beds more likely to develop cutaneous melanoma. It can be cured if it is found and treated early. The treatment includes surgical removal of the cancer cells [2].

Skin Structure

The skin structure is shown in fig 1. Skin contains three types of cells.

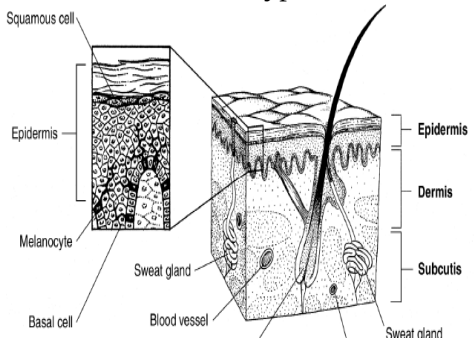


Fig 1. Structure of the Skin

- **Squamous Cells**: Flat cells in the outer part of the epidermis.
- **Basal Cells**: Basal cell layers are the lower part of the epidermis; these cells are constantly divided to form new cells to replace the squamous cells.
- **Melanocytes**: Melanocytes are pigment cells, which produce the cutaneous melanoma, it makes the brown pigment called melanin, and it protects the deeper layers of the skin.Malignant or cancerous melanomas are brown-to- black pigmented lesions. The types of Skin Cutaneous melanoma are:
- Superficial spreading melanoma is the most common type. It is more commonly found on the arms, legs, chest and back. The melanoma cells generally raise slowly at first, and spread out across the surface of the skin.
- Nodular melanoma is the second most common type. It can grow more quickly than other melanomas. It is also more likely to lose its color when growing, becoming red rather than black. It is more commonly found on the chest, back, head or neck.
- Lentigo maligna melanoma is less common. It is usually found in older people. It is often found on the face and neck. It usually grows slowly and more dangerous than the other types of melanoma.
- Acral lentignous melanoma is the rarest type. It is usually found on the palms of the hands, soles of the feet, or under fingernails or toenails. It is more common in people with black or brown skin. It is not thought to be related to sun exposure [3].

- In this paper, a Threshold technique to detect affected skin legions using morphological and edge detection operations is proposed. The segmented image is classified into benign or highly suspicious stage based on ABCD rule with TDS (Total Dermoscopy Score) value. Finally, the stage of the skin lesion is detected. The paper is organized as follows: In Section II different types of skin lesion detection techniques are reviewed. The proposed method is discussed in Section III.
- The features of the skin lesions are analyzed in Section IV.
- Finally the conclusion and future direction of work is made in Section V.

2. LITERATURE SURVEY

A literature survey on Digital Image Processing Techniques to detect cutaneous melanoma skin lesion from the skin images is provided below:

Amran Hossen Bhuiyan (2013) et.al, proposed a color based image segmentation using K-means clustering. It is divided into two stages. In first stage, with the help of de-correlation stretching the color separation of image is carried out and later the regions are grouped into set of three classes using K-means clustering. By using region based color separation, the overhead of calculating feature extraction for every pixe l is reduced [4].

Rajiv Parikh (2013) et.al, proposed a method to deal with noise reduction and extracting information for the image for accurate detection of the type of skin lesion [5].

Pauline (2015) et.al, proposed a method to classify the skin cancer using watershed method and edge detection with the PCA (Principal Component Analysis) method [6].

Jeya Ramya (2015) et.al, proposed a method to find the affected skin lesion area using active contour segmentation. The parameters are calculated for asymmetry, border, color and diameter [7].

Ebtihal AlMansour (2017) et.al, proposed a technique that imple ments a simple algorithm for the detection of skin cancer and to find the shape and infected area. Pre processing is done using median filter and in second step segmentation is done by Threshold and Fuzzy c-means methods and the feature extraction is done by Gray Level Co-occurrence Matrix (GLCM) [8].

3. METHO DOLOGY AND PROPOSED WORK

Detection of cutaneous melanoma skin legion from the skin image contains two main tasks. First, the affected skin lesion is detected from a human skin image and skin lesion features are extracted using ABCD rule with TDS calculation. The frame work of the proposed research work is shown in Fig 2.

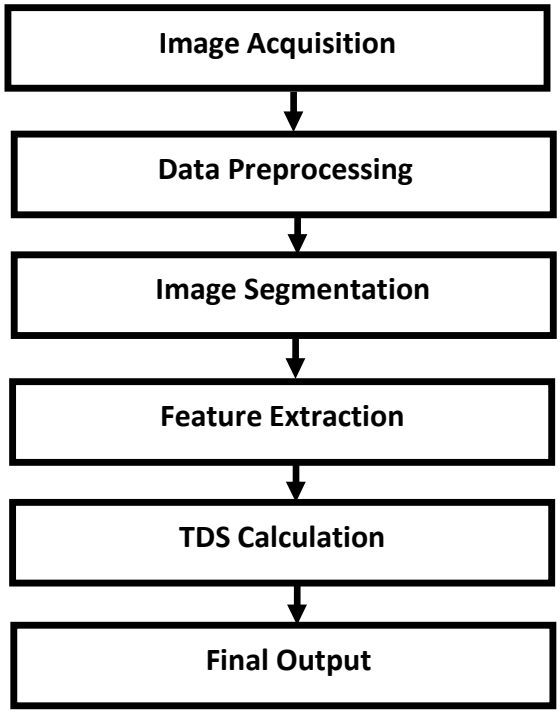


Fig 2. Framework of the Proposed Cutaneous Melanoma Skin Legion Detection

3.1. Image Acquisition

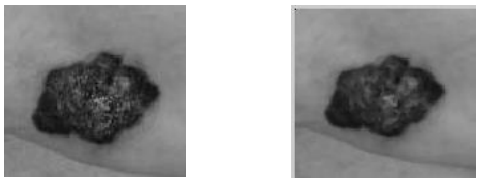
The skin lesion images are captured using a digital camera and acquired image will be in RGB color model stored in .jpg format with different sizes. For computational efficiency, all the images are resized into 140* 140. A sample input skin lesion image is shown in Fig 3.

Original Image resized with 135×135

Fig 3. Image Acquisition

3.2. Preprocessing

During image acquisition, the original RGB image is converted into a grayscale image. The input image may be corrupted with some undesired impulsive noises, such as hair, oil bubbles and scars. In preprocessing phase, Median Filter is applied to reduce the noise of an input image and to increase the accuracy and clarity. The preprocessed noise free image is shown in Fig 4.



a) Original Image b) Noise Smoothened

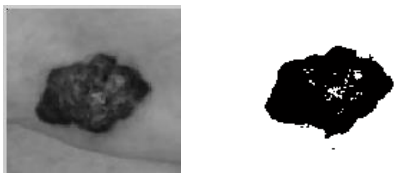
Fig 4. Pre-processed Image

3.3. Image Segmentation

The procedure to extract the affected skin lesion from the skinimage is given below:

Step 1:

To extract the affected skin lesion from the skin Threshold technique is proposed. Threshold image segmentation technique is a simplest method of image segmentation. The grayscale image is converted into a bi-level image. The graythres () function is used to extract the foreground objects. The segmented Threshold image is shown in Fig 5.



a) Noise Free Image b) Binary Image

Fig 5. Thresholding Image

Step 2:

The morphological opening operations are used to eliminate the small objects of white pixe ls inside the region. The morphological area open image is shown in Fig 6.

Fig 6.a) Binary Image b) Areaopen image

Step 3:
The edges contain information about object boundaries which is useful for image analysis and object recognition. In this proposed work, the sobel operator is used to detect the edge of the affected skin lesion. The edge detection image is shown in Fig 7.

a) Area Open Image b) Boundary Image
Fig 7. Edge Based Boundary Detection

Step 4:
A boundary is extracted from the skin lesion image is taken as a mask and applied on the original image. A mask is a filter is also known as spatial filtering. It involves in setting the pixe l values in an image to zero, or some other "background" value. The extracted lesion region shown in Fig 8.

a) Boundary Image b) Mask Image

Fig 8. Extracted Lesion Region

Step 5:
In the extracted skin region, the skin lesion border is not clear in the foreground image and some discontinuities are identified. To overcome this problem, the resultant mask is complemented and a morphological erosion and Dilation operation applied to extract the abnormal skin lesion region with continuous boundary is finally obtained using this step.

a) Foreground Image b) Complement Image

Fig 9. Detection of Foreground Skin Lesion Only

a) Complement Image b) Erode Image

Fig 10. Output of Extracted Skin Lesion Image

3.4. Feature Extraction

After the skin lesion region is extracted the ABCD (Asymmetry, Border Irregularity, Color, and Diameter) features are calculated. Then extracted Affected skin lesion area calculated and features are extracted for ABCD (Asymmetry, Border Irregularity, Color, Diameter and Perimeter) rule based on TDS calculation with classification of affected skin lesion. The following features are extracted,

Skin Lesion Area

The affected skin lesion area is calculated by counting the number of pixel values. The sample code is given below.

area1 = sum (I2 (:)); Area=area1* 0.264583333;Display (area);

Perimeter

Perimeter calculation formula is given in equation (1),

$$\text{Perimter} = n_e + \sqrt{2n_0} \quad \text{---------(1)}$$

where, n_e- Number of even pixel &n_o - Number of odd pixels

Asymmetry

Asymmetry is calculated by finding the area of non overlapping section and the difference between the normal and detected skin lesion area. The mathematical expressions used to calculate the asymmetric value is given in equation (2),

$$\text{Asymmetry} = \overline{\Delta A} * 100 \quad \text{----(2)}$$

where, ΔA - Pixel Difference &A – Total Pixel Count of the Lesion

Border Irregularity

In case of cutaneous melanoma the borders of the lesion are irregular or blurred. So, the edge or the border is first predicted and then fetched from the image excluding the inner and outer parts of the mole. Border irregularity calculation is given in equation (3),

$$\text{Border} = [\text{Perimeter}^2/4\pi A] \quad \text{--(3)}$$

where, A= Area of the lesion & $\pi = 22/7$

Color

The RGB image is converted to HSV color image. The standard deviation of the HSV color values of all the pixels, and skin lesions are calculated. This standard deviation value is taken as the color variation risk. A higher color standard deviation is considered to be a higher cancer risk or benign melanocytic lesion.

Diameter

The value of the diameter is calculated as below:

$$\text{Diameter} = \sqrt{4 * (A) / \text{Perimeter}} \quad \text{----(4)}$$

where, A- Area of the Lesion

TDS Calculation

From the ABCD feature values the TDS (Total Dermoscopy Score) value is calculated to the extracted skin lesion. If the TDS value is <4.75 the skin lesion is identified as a benign skin lesion and if it is in between 4.75 and 5.45, the skin lesion is a highly suspicious cutaneous melanoma. And finally if the value is 6, then it is a normal skin region. The TDS value is calculated as below:

$$(A * 1.3) + (B * 0.1) + (C * 0.5) + TDS = \blacklozenge \quad \text{----(5)}$$

Table I: FINAL Classification for ABCD Rule

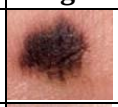
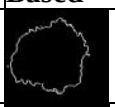
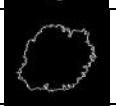
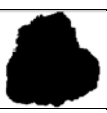
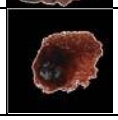
Input Image	A	B	C	D	TDS	Result
Image1	1.49	0.60	0.24	2.33	2.45	Benign
Image2	1.50	0.61	0.23	2.64	4.02	Benign
Image3	3.72	1.54	0.18	1.93	7.44	Cancer
Image4	0.71	0.95	0.28	2.58	3.31	Benign
Image5	2.00	0.80	0.22	2.33	4.70	Benign

TDS (Total Dermoscopy Score)	Interpretation
<4.75	Benign melanocytic lesion
>5.45	Highly malignant melanoma

4. EXPERIMENTAL RESULTS AND ANALYSIS

Sample of input skin lesion images are taken, segmented and the results are analyzed. The segmented skin regions are provided in Table II and the experimental results are shown in Table III.

Table II: Proposed Skin Lesion DetectionTechnique

S.No	Original Image	Segmentation Technique		
		Threshold Based	Edge Based	Extract Skin Lesion Image
1				
2				
3				
4				
5				

5. CONCLUSION

The most prevalent illness that affects both men and women is skin cancer. Early skin cancer screening facilitates a quicker recovery from the illness. The goal of this research project is to identify Cutaneous Melanoma Skin Cancer by identifying the damaged skin regions from skin lesion photos. Threshold-based segmentation, edge-based boundary detection, and morphological techniques are used to extract the skin lesion border in order to identify the affected skin region. ABCD and TDS values are calculated for the images. The experimental results are evaluated and the Cutaneous Cutaneous melanoma Skin Cancer is diagnosed based on the TDS values of the image. In future, this research work may be extended to extract the skin lesion color from the features of affected skin lesion.

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