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# Computer aided Melanoma skin cancer detection using Image Processing

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**Abstract**

In recent days, skin cancer is seen as one of the most Hazardous form of the Cancers found in Humans. Skin cancer is found in various types such as Melanoma, Basal and Squamous cell Carcinoma among which Melanoma is the most unpredictable. 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. In this paper, we present a computer aided 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 novel image processing techniques, it analyses it to conclude about the presence of skin cancer. 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.

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*Keywords:Melona; Skin Cance;Image Segmentation; Preprocessing; EdgeDetection; Color Threshloding; Blob detection; Binary Masks.*

## 1. Introduction

Melanoma is a particularly deadly form of skin cancer and although it accounts for only 4% of all skin cancers it is responsible for 75% of all skin cancer deaths. If melanoma is diagnosed and treated in its early stages, it can be cured but if the diagnosis becomes late, melanoma can grow deeper into the skin and spread to other parts of the body. It's spread in other parts beyond the skin can be hazardous as it is difficult to treat. The presence of Melanocytes in any body part causes the Melanoma . Intensive Exposure of skin to ultraviolet radiation is the main cause of the melanoma.

Dermoscopy is a non-invasive examination technique based on the use of incident light and oil immersion to make possible the visual examination of sub surface structures of the skin. Though the detection of melanoma using dermoscopy is higher than unaided observation based detection[3],it's diagnostic accuracy depends on the training of the dermatologist. The diagnosis of melanoma from melanocytic nevi is not straight forward especially in the early stage. Thus, automatic diagnosis tool is essential for physicians. Even when the expert dermatologists uses the dermoscopy for diagnosis, the accuracy of melanoma diagnosis is estimated to be about 75-84%.[4] The computer aided diagnostics is helpful to increase the diagnosis accuracy as well as the speed. Computer is not more intelligent than human but it may be able to extract some information, like color variation, asymmetry, texture features, that may not be readily perceived by human eyes. There have been many proposed systems and algorithms such as the seven-point checklist, ABCD rule, and the Menzies method[2,3] to improve the diagnostics of the melanoma skin cancer.

The key steps in a computer-vision based diagnosis of melanoma are: image acquisition of skin lesion image, segmentation of the skin lesion from skin region, extraction of features of the lesion blob and feature classification. *Segmentation* or *border detection* is the process of separating the lesion from the surrounding skin in order to form the region of interest.

*Feature extraction* is used to extract the features; similar to those visually detected by dermatologists, that accurately characterizes a melanoma lesion. The feature extraction methodology of many computerised melanoma detection systems has been largely based on the conventional clinical algorithm of ABCD-rule of dermoscopy due to its effectiveness and simplicity of implementation. Its effectiveness stems from the fact that it incorporates the main features of a melanoma lesion such as asymmetry, border irregularity, colour and diameter (or differential structures), where quantitative measures can be computed.

## 2. Related Work

Many researchers have been working on the Computer vision approach for skin cancer detection. For segmentation of skin lesion in the input image, existing systems either use manual, semi-automatic or fully automatic border detection methods. The features to perform skin lesion segmentation used in various papers are: shape, colour, texture, and luminance. Many border detection methods are reported in the literature[5,6] Some of the methods include histogram thresholding[7], global thresholding on optimised colour channels followed by morphological operations[8], Hybrid thresholding.[8] In this study, we have applied Automatic thresholding and border detection method. Different image processing techniques have been used to extract such features, see for example.[5,10,11] In [5],author has introduced an automated Global border-detection method in dermoscopy images based on colour-space analysis and global histogram thresholding which exhibits high performance in detecting the borders of melanoma lesions. In [10]. the authors have used the technique of dividing the input image into various clinically significant regions using the Euclidean distance transform for the extraction of color and texture features. The ABCD rule of dermoscopy[13], suggest that asymmetry is given the most prominent among the four features of asymmetry, border irregularity, colour and diameter. A number of studies have been carried out on quantifying

asymmetry in skin lesions. In Some techniques, the symmetry feature is calculated based on geometrical measurements on the whole lesion, e.g. symmetric distance and circularity[9] Other studies, propose the circularity index, as a measure of irregularity of borders in dermoscopy images[14,1] The paper [11] gives the overview of the most important implementations in the literature and compares the performance of several classifiers on the specific skin lesion diagnostic problem.

## 3. Methodology

The proposed methodology for Melanoma Skin Cancer Detection using Image Processing is as shown in Fig. 1. The input for the system is the image of the skin lesion which is suspected to be a melanoma lesion. This image is then pre-processed to enhance the image quality. The automatic thresholding process and edge detection is used for image segmentation. The segmented image is given to the feature extraction block which consists of lesion region analysis for its geometrical features and ABCD features. The geometrical features are proposed since they are the most prominent features of the skin cancer lesion. The extracted feature are further given to the feature classification stage which classifies the skin lesion as cancerous or normal by comparing its feature parameters with the pre-defined thresholds.

## 4. System Flow Diagram

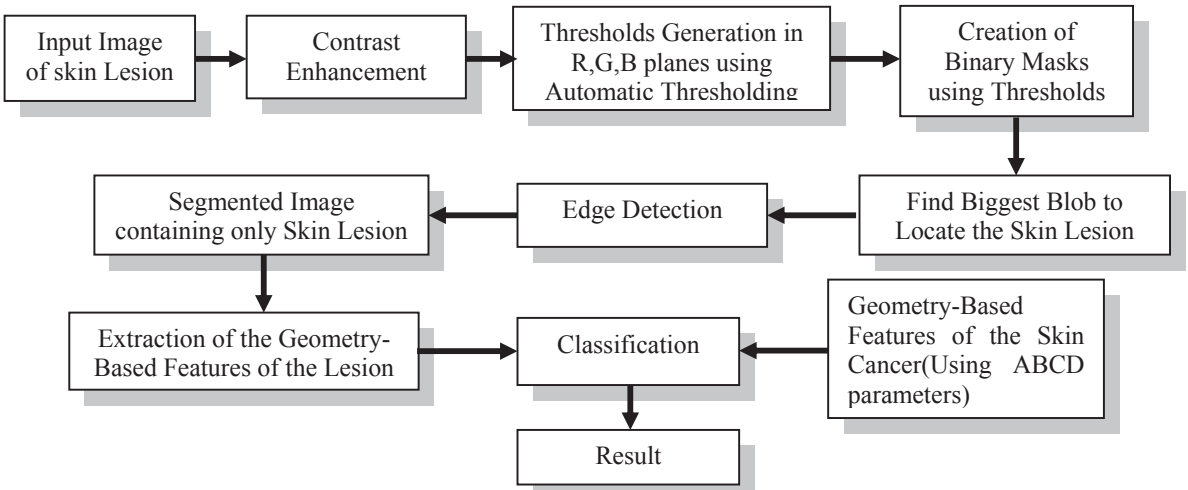


Fig.1. System Flow Diagram

## 5. The Proposed Technique

### *5.1. Image Pre-processing*

The input image given to the system can be obtained in any lighting condition or by using any camera such as mobile camera. Hence it needs to be pre-processed. Here, the pre-processing includes the image resizing and contrast and brightness adjustment. This is done in order to compensate the non-uniform illumination in the image. These processes are done by using image processing techniques like gamma correction.

### *5.2. Image Segmentation*

Image segmentation is performed by using our proposed automatic thresholding and masking operation in R,G and B planes. First, automatic thresholding proposed by Otsu[12] is applied in each plane. Binary masks for each plane are obtained and then combined to produce a final lesion mask. We use 3-plane masking procedure to increase

segmentation accuracy. Then edge detection is applied to further segmentation. The main prerequisite for extracting the features is that the lesion must be separated from the surrounding normal skin. But the segmented image may contain other smaller blobs which are not the skin lesion. To overcome this, we find the biggest blob in the segmented image. The segmented image obtained contains only the skin lesion.

*5.3. Feature Extraction*

The main features of the Melanoma skin Lesion are its Geometric Feature. Hence, we propose to extract the Geometric Features of segmented skin lesion. Here, we used some standard geometry features (Area, Perimeter, Greatest Diameter, Circularity Index, Irregularity Index) adopted from.[11]

From the Segmented image containing only skin lesion, the image blob of the skin lesion is analyzed to extract the its geometrical features. The Different Features extracted are as follows:

Area (A): Number of pixels of the lesion.

Perimeter (P): Number of edge pixels.

*Major Axis Length or Greatest Diameter (GD):* The length of the line passing through lesion centroid and connecting the two farthest boundary points.

$$(x_c, y_c) = \left(\frac{\sum_{i=1}^{n} x_i}{n}, \frac{\sum_{i=1}^{n} y_i}{n}\right) \quad \text{.....(1)}$$

where n is the number of pixels inside the lesion, and $(x_i, y_i)$ is the coordinates of the $i^{th}$ lesion pixel.

*Minor Axis Length or Shortest Diameter (SD):* The length of the line passing through lesion blob centroid and connecting the two nearest boundary points.

*Circularity Index (CRC):*It gives the shape uniformity.

$$CRC = \frac{4A\pi}{P^2} \quad \text{.....(2)}$$

*Irregularity Index A (IrA):*

$$IrA = \frac{P}{A} \quad \text{.....(3)}$$

*Irregularity Index B (IrB):*

$$IrB = \frac{P}{GD} \quad \text{.....(4)}$$

*Irregularity Index C (IrC):*

$$IrC = P \times \left(\frac{1}{\mathrm{SD}} - \frac{1}{\mathrm{GD}}\right) \quad \text{.....(5)}$$

*Irregularity Index D (IrD):*

$$IrD = \mathrm{GD} - \mathrm{SD} \quad \text{.....(6)}$$

*5.4. Classification:*

Using the ABCD rules for the melanoma skin cancer, we use some pre-defined thresholds in classification stage. The Feature Values Extracted in the Feature Extraction stage are compared and the skin lesion is classified as Melanoma Skin Cancer or normal skin or Mole. This classification method proves to be efficient for most of the skin images.

## 6. Results and Discussion

First, the Skin Lesion Mask is formed and then it is applied on the input image to obtain the segmented image. As shown in Fig 6 and Fig7. input image of the skin lesion is efficiently segmented for both mole as well as Melanoma Cancer Image using proposed segmentation method.

Fig2.These are the original images which we take as input the image on the left is cancer image and on the right is mole

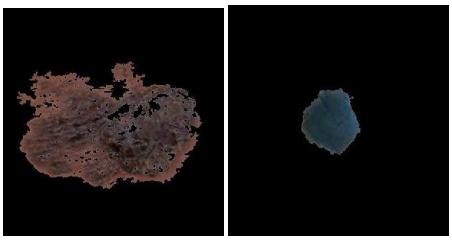

Fig3. Mask Is created

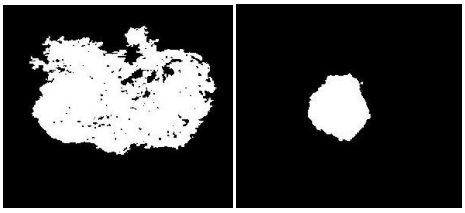

Fig4.These are the images which shows the biggest blob detected in the input image.

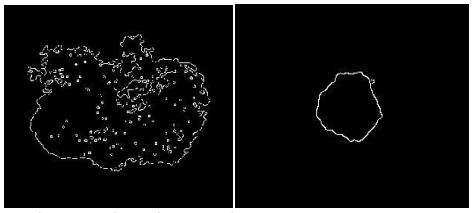

Fig. 5 Edge detected

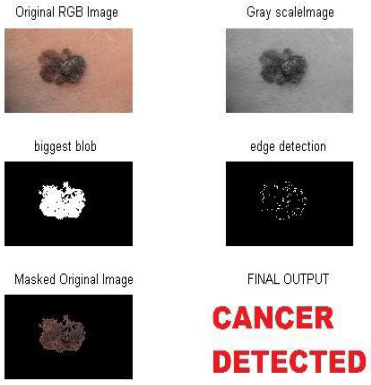


Fig.6 Cancer detected


Fig.7. Cancer not detected

## 7. Conclusion

In this paper we have discussed a computer-aided diagnosis system for melanoma skin cancer. It can be concluded from the results that the proposed system can be effectively used by patients and physicians to diagnose the skin cancer more accurately. This tool is more useful for the rural areas where the experts in the medical field may not be available. Since the tool is made more user friendly and robust for images acquired in any conditions, it can serve the purpose of automatic diagnostics of the Skin Cancer.

## References

1. A. Bono, S. Tomatis, and C. Bartoli, *The ABCD system of melanoma detection: A spectrophotometric analysis of the asymmetry,border, color, and dimension*, "Cancer", vol. 85, no. 1, pp. 72–77, January 1999
2. Pehamberger H, Binder M, Steiner A, Wolff K. *In vivo epiluminescence microscopy: improvement of early diagnosis of melanoma*. J Invest Dermatol,100:356S–62S, 1993
3. Bafounta ML, Beauchet A, Aegerter P, Saiag P. *Is dermoscopy (epiluminescence microscopy) useful for the diagnosis of melanoma? Results of a meta-analysis using techniques adapted to the evaluation of diagnostic tests*. Arch Dermatol,137:13,43–50. 2001
4. G.Argenziano, H. Soyer, S. Chimenti, R. Talamini, R. Corona, F. Sera, and M. Binder, *Dermoscopy of pigmented skin lesions: Results of consensus meeting via the Internet Journal of the American Academy of Dermatology*, vol. 48, pp. 679–693, 2003
5. R. Garnavi, *Computer-aided diagnosis of melanoma*, Ph.D. dissertation, University of Melbourne, Australia, 2011
6. M.E. Celebi, H. Iyatomi, G. Schaefer, and W. V. Stoecker, *Lesion border detection in dermoscopy images Computerised Medical Imaging and Graphics*, vol. 33, no. 2, pp. 148–153, 2009
7. H. Iyatomi, H. Oka, M. Saito, A. Miyake, M. Kimoto, J. Yamagami, S. Kobayashi, A. Tanikawa, M. Hagiwara, K. Ogawa, G. Argenziano, H. P. Soyer, and M. Tanaka, *Quantitative assessment of tumour extraction from dermoscopy images and evaluation of computer-based extraction methods for an automatic melanoma diagnostic system* Melanoma Research, vol. 16, no. 2, pp. 183–190, 2006
8. R. Garnavi, M. Aldeen, M. E. Celebi, A. Bhuiyan, C. Dolianitis, and G. Varigos, *Automatic segmentation of dermoscopy images using histogram thresholding on optimal color channels* International Journal of Medicine and Medical Sciences, vol. 1, no. 2, pp. 126–134, 2010
9. V. Ng, B. Fung, and T. Lee, *Determining the asymmetry of skin lesion with fuzzy* borders *Computers in Biology and Med.*, vol. 35, pp. 103–120, 2005
10. M. Celebi, H. Kingravi, B. Uddin, H. Iyatomi, Y. Aslandogan, W. Stoecker, and R. Moss, *A methodological approach to the classification of dermoscopy images*, Computerized Medical Imaging and Graphics, vol. 31, pp. 362–373, 2007
11. I. Maglogiannis and C. Doukas, *Overview of advanced computer vision systems for skin lesions characterization* IEEE Trans. on Information Technology in Biomedicine, vol. 13, no. 5, pp. 721–733, 2009
12. Otsu, N., *A Threshold Selection Method from Gray-Level Histograms* IEEE Transactions on Systems, Man, and Cybernetics, Vol. 9, No. 1, pp. 62-66,1979
13. W. Stolz, A. Riemann, and A. Cognetta, *ABCD rule of dermatoscopy:A new practical method for early recognition of malignant melanoma*, European Journal of Dermatology, vol. 4, pp. 521–527, 1994
14. Z. She, Y. Liu, and A. Damatoa, *Combination of features from skin pattern and ABCD analysis for lesion* classification Skin Research and Technology, vol. 13, pp. 25–33, 2007