A Review of Threshold based Segmentation for Skin Cancer with Image Processing

T.D. Srividya, V. Arulmozhi

Abstract--- Detecting skin cancer in premature stage is vital and decisive. Nowadays skin cancer is considered as the most hazardous forms of cancer in humans. Skin cancer are of various types such as Melanoma, Basal and Squamous cell carcinoma, amongst Melanoma is most erratic. The Malignant Melanoma is one of the dangerous in humans. Early diagnosis can be curable. In Medical Image Diagnosis Computer vision plays an important role which is proved by many existing systems.

This paper explains the method for detection of melanoma using image processing tools. The Efficient tools supporting quantitative medical diagnosis are computer analysis and image processing. So the feature extraction phase is enormously dependent on the detected region which has the disease. So suitable segmentation algorithm is required which can effectively detect the skin melanoma pixels in the information image. In this work, we have discussed various techniques which are used in the segmentation procedure.

This paper focuses on the method for the detecting Melanoma Skin Cancer by Segmentation. The input to the system is the Dermoscopic Image and then by applying novel image processing techniques. The pre-processing approaches employed in detecting various stages include collection of Dermoscopic Images, filtering the images by using Dull Razor filtering for removing hairs and air bubbles in the image, converting to gray scale, noise filtering, segmenting the images using threshold, hybrid threshold, iterative threshold, multilevel thresholding and Automatic Threshold.

Keywords--- Skin cancer, Segmentation, Thresholding, Melanoma Detection, Digital Image, Carcinoma.

I. INTRODUCTION

Skin is the outermost layer in human body which acts as a protective defense against foreign particles. Many diseases are affecting the human body such as skin cancer. In normal situation cells grow normally in which old cells are replaced by the new ones. In case of cancer, cells grow abnormally. When not diagnosed early leads to death. Most skin cancers are caused due to over exposure to Ultraviolet rays(UV) rays. Diagnosis of malicious malignancy is a difficult task. Melanoma is one such category of skin cancer that develops from the pigmented cells called melanocytes.

The next type of skin cancer is Basal cell which occurs in the basal cell covering of skin. Usually found in face region due to exposure to sun. The other one is Squamous cell skin cancer found in Squamous cells, found in leg or foot. It has been proved that the death rate in Malignant Melanoma is 3 times than other skin cancer types.[1]. The important steps in diagnosis of melanoma skin cancer are[2]:

- image acquisition of lesion image
- segmentation of the lesion area from the outer area
- extraction of the features from the input image

The computer aided methodology for the detection of Melanoma Skin Cancer using Image processing tools is employed in this work. The skin lesion image is given as input for the system, using image processing techniques which concludes about the incidence of cancer.

II. LITERATURE SURVEY

Ebtihal Almansour et al devised a methodology that is compared with the state of the art methodology. The four color feature formulas are given in this method. The GLCM method is used. The classical statistical texture features like entropy, energy, contrast, correlation & homogeneity are discussed here. Analysing the results of GLCM feature set, LBP, TF, CF, TCF it is proved that color is an important factor to distinguish melanoma & non-melanoma.

S. Gopinathan et al proposes an otsu segmentation methodology that segments the lesion from the entire image. For further segmentation the Boundary tracing algorithm is used. For classification, Stolz algorithm is used and results are presented in the form of tables and graphs. The filters used here are Gaussian noise with standard deviation of 0.5. Sanjay Jaiswar et al has given a method in which after image pre-processing, the segmentation techniques of threshold based, clustering techniques, edge detection based are used. And the feature extraction features such as ABCD and TDS is calculated. The proposed work may provide encryption of data & authentication for users. A more interactive and user-friendly system is proposed in the near future.

Saudamini S. Jivtode et al suggested a method for which filtering is done by Dull Razor filtering for removing hairs and air bubbles in the image, converting to gray scale image, contrast enhancement , noise filtering , segmentation using Max entropy threshold. The sensitivity and specificity by NN of Raman spectra were identified in this work.

A S Deshpande et al put-forth a methodology in which the image is pre-processed using median filter for noise removal. For segmentation Fuzzy C-Means is used. GLCM is used and classification is done by SVM. He concludes that SVM is always correct.

Ruchika Sharma et al proposed segmentation methods such as edge detection, thresholding, region based, based on clustering. The unsupervised learning algorithms such as K-Means clustering & Fuzzy C-means are used.ANN segmentation also used. This work shows the comparison between all available segmentation techniques.

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M Chaitanya Krishna et al uses CAD to differentiate normal and melanoma skin cancer lesion. Pre-processing of the image is done based on image illumination equalization, color range normalization and image scale fitting or image resolution normalization. The segmentation techniques used are threshold based, edge detection based and clustering techniques. The step and change detection are employed here and TDS formula is given.

Nabin K Mishra et al discusses various aspects of lesion segmentation where machine learning algorithms are used. The three major stages in this work are lesion segmentation, feature segmentation and classification.

Ebtihal Aalmansour et al discusses the death rate of melanoma is three times than other cancers. The proposed method uses two types of texture feature and compared it with the state of the art method. Four color feature formulas are given. GLCM and SVM classifiers are used. The dataset contains 69 dermoscopic images, 43 melanoma images and 26 non-melanoma images collected from Dermatology Information System (Dermis). He concludes that color is very important to distinguish melanoma and non-melanoma.

Swathi K et al uses CAD techniques in which four stages are identified. Various classifiers are used and 84 directional filters are used.

HinaSood et al devised a method for merging of segmentation using Genetic algorithm. The lesion segmentation is compared with other algorithms. Various segmentation methods employed here are adaptive thresholding, Fuzzy based split and merge , Gradient Vector flow(GVF) and Expectation Maximization Level (EM-LS).He also concluded an another approach to detect skin lesion is to find out the best thresholds with the help of mutli-level adaptive thresholding. The formulas for sensitivity, specificity, accuracy are given and he concluded by providing a unique algorithm.

III. TOOLS

Dull Razor filtering, segmentation using various thresholding, image extraction using MATLAB.

IV. APPLICATION

- Image sharpening and restoration
- Medical field
- Transmission and encoding
- Machine/Robot vision
- Color processing
- Pattern recognition
- Video processing
- Microscopic Imaging
- Soft computing

V. PROBLEM IDENTIFICATION

Human cancer is an intricate disease which is caused primarily by accumulation of multiple molecular alternation and genetic instability. Among many types of cancer, skin cancers are most common. There are two major types of skin cancer, name malignant melanoma and non-melanoma (basal cell, squamous cell, and Markel cell carcinomas, etc.) [3].Melanoma is more dangerous and can be fatal if not treated. Color was taken to be an essential criteria for distinguishing melanoma from non-melanoma[1].If melanoma is detected in its early stages, it is highly curable, yet advanced melanoma is lethal. It is well-known that early finding and treatment of skin cancer can reduce the mortality and morbidity of patients. Multilevel thresholding is suited for both dermoscopic and digital images.[3].

VI. METHODOLOGY

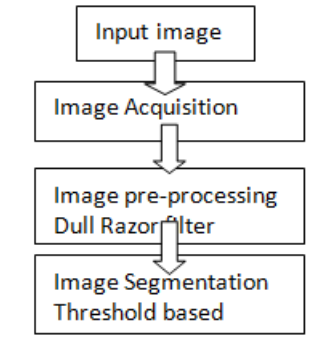
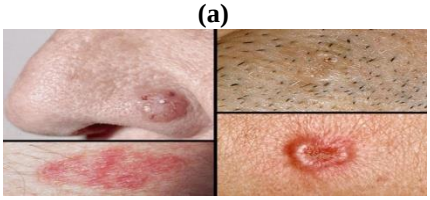


Image Acquisition

Image acquisition is defined as the process of capturing or retrieving an image from a camera, so it can be passed through various processes. Image acquisition in image processing is the first step in the workflow sequence since, without an image, no further process is possible[3]. The input images are Dermoscopic images, taken with conventional camera equipped with special lens extension. The lens of thedermatoscope acts like a microscope magnifier with its own light source that illumes the skin surface evenly. Several types of dermoscopy equipment exist, all use same principle.

(a)



(b)

(c)

Figure 1: Original image (a) Melanoma (b) Basal Cell carcinoma (c) Squamous cell carcinoma

Image Pre-processing

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Pre-processing is defined as the alteration of the image which remove unnecessary noise. First, the image is resized to adjust images to a uniform scale . After that, images are converted from RGB (Red, Green, and Blue) to grey level .Image pre-processing includes image resizing, hairremoval, brightness etc. The image is given as input, it checks for the lesion image ,if so it proceeds for preprocessing[4].Usually the input image has noise like hair, so in order to remove such noises, Dull Razor filter is applied. For the case of melanoma skin cancer, the most common type of noise is hair, for this intent Dull Razor filter is used. Here images are processed in order to remove information that can later used to classify those images[3][4].

Algorithm

For preprocessing skin cancer image

1. Read image.
2. Separate R, G and B plane from color image.
3. Apply dull razor filter on each of above 3 planes separately.
4. Combine above 3 planes to form noise filtered color image.
5. Increase contrast of image using im adjust function.

(a) (b)

Figure 2: (a) RGB to Gray scale image
(b) Image after removing noise by Dull razor filter

Segmentation

Threshold Based Segmentation:

One of the easiest methods of segmentation in which a gray scale image is converted into binary image. They may be applied directly to an image, but can also be combined with pre- and post-processing techniques[6].

Hybrid based Threshold

One of the segmentation methods used for the automatic detection of melanoma.[3] when compared to manual borders by dermatologists, the borders are less thick. Hybrid thresholding are classified as global and local thresholding.

Iterative Based Threshold

This type of threshold based segmenatation is used for intensity images which measure the light effects or brightness in the image. For identifying the lesion boundary double thresholding and elastic curve fitting method are used. The RGB image space is transformed into two intensity images. One is HVC color space, since human color perception and HVC color perception are same[7].

Multilevel based Threshold

For any input image depending on the threshold pixel by pixel image segmentation is performed.

Automatic Threshold

A novel method of extracting pixel information with the background noise being minimized is Automatic thresholding. This is accomplished by utilizing a feedback loop to optimize the threshold value before converting the original grayscale image to binary. The image is isolated into two parts; the background and foreground[10].

1. Select initial threshold value, typically the mean 8-bit value of the original image.
2. Partition the original image into two segments;
   i. Pixel values less than or equal to the threshold are referred to as background
   ii. Pixel values greater than the threshold are considered as foreground
3. Find the average mean values of the two new images
4. Calculate the new threshold by averaging the two means.
5. The output is reached if the difference between the new threshold and previous threshold is within a specified range. Else the new threshold is applied on the original image.

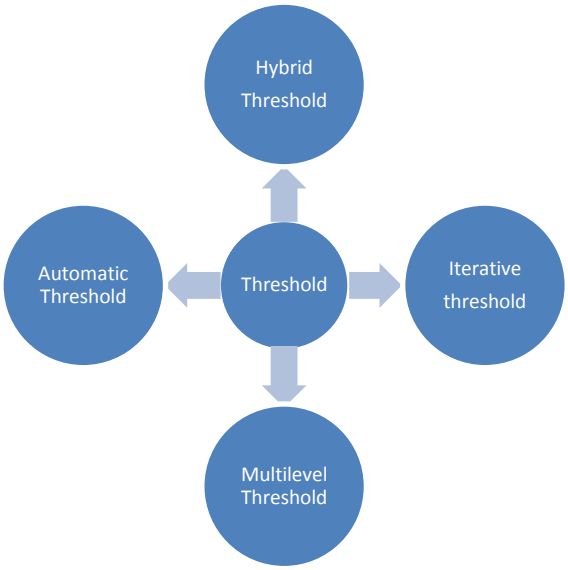

Figure 3: Thresholding Methods

Algorithm for segmentation

i. Convert the given image into vector
ii. To form two different clusters on this image vector, apply FCM algorithm. One cluster correspond to background skin and the other one to cancer region.
iii. If number of pixels in cluster 1 is more then it is background and cancer region is cluster 2.
iv. The result may include some unnecessary region which are removed and maximum area is calculated.
v. The result obtained by FCM is Black White image which enclose black color in background region and white color in cancer region. The corresponding cancer part is kept as it is and skin part is removed.

VII. CONCLUSION

With the invention of technology skin cancer detection using image processing becomes easy. Early detection of melanoma is very important since it reduces the death rate by 3 times[8].

The final output given by the system helps dermatologists to diagnose more accurately. In this paper color is considered to be the most important characteristic to diagnose skin cancer. In this review paper the various types of thresholding based approaches are used for efficient diagnosis. In future the system can be made more reliable, user friendly and more robust.

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