



Review of Segmentation Techniques for Melanoma Detection

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Abstract— *The malignant melanoma is one of the deadly form of tumors of the skin in humans. It is hazardous in light of the fact that it develops quickly and effortlessly metastasizes. Late identification of the malignant melanoma is in charge of 75% of deaths connected with skin growths. Therefore, early diagnosis is an important factor that increases the chance of successful cure as there is rapid course of the disease. The Efficient tools supporting quantitative medical diagnosis are computer analysis and image processing. It is relevant to develop computer based methods for dermatological images. So in order to get the effective results and information of distinctive stages of the infected portion, the corresponding features of that particular area are required in order to decide the stage. So the feature extraction phase is enormously dependent on the region detected which has the disease. So suitable segmentation algorithm is required which can affectively detect the skin melanoma pixels in the information image. In this work, we have discussed various techniques which are used in the segmentation procedure.*

Keywords— *Melanoma, Segmentation, Clustering, ANN.*

I. INTRODUCTION

Computer-aided diagnosis (CAD) systems have been quickly being developed over the previous decade for skin cancer classification. An impressive role of CAD systems is to give a “second opinion” to the dermatologists to make decision for successful diagnosis of patients. In dermatology, the significant types of lesions for skin cancer are divided into malignant melanoma and non-melanoma. On Comparing to the current melanoma CAD systems, the recognition rate of non-melanoma skin lesions is less than 75% may be because of the presence of many lesions appearances. An important amount of studies have demonstrated that the measurement of tissue lesion features may be of crucial importance in clinical practice. This is because of the reason distinguished tissue lesions can be identified based on measurable features which are derived from an image. In the most recent years, computer vision-based diagnostic systems have been utilized in several hospitals and dermatology clinics. Which aims for the most part at the early identification of harmful melanoma tumor and also this is among the most frequent types of skin cancer, other types of non-malignant cutaneous diseases. Seriousness in melanoma is due to the fact that its occurrence has increased quicker than all other cancers. The annual extend rates have increased on the order of 3–7% in humans having fair-skinned rather others in late decades [1]. The progressive cutaneous melanoma is still hopeless, but when analyzed at early stages it can be cured without any complications. The separation of early melanoma from other non-malignant pigmented skin lesions is not negligible even for experienced dermatologists. In certain cases primary care physicians miscalculate melanoma in its early stage [2]. In this paper, the problems of skin image segmentation using a hybrid path for the separation of pigmented skin lesions from normal skin and the feature extraction from the separated regions are analyzed.

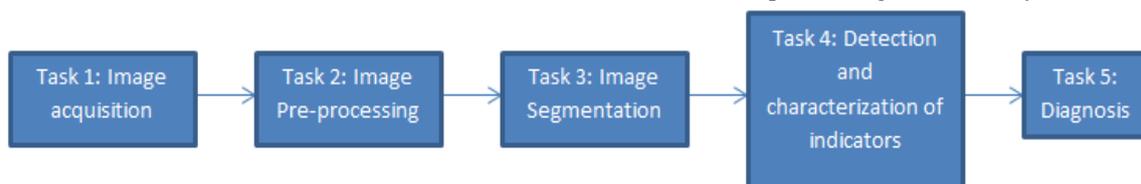


Fig. 2: Tasks of the life cycle of an automated system for the detection of melanoma

II. LIFE CYCLE OF AN AUTOMATED SYSTEM FOR THE DETECTION OF MELANOMA

Using the dermoscopic technique the complete life cycle of an automated system for the identification of melanoma, as can be seen in Fig. 2, consists on the following stages:

A. Image acquisition:

The acquisition of the dermoscopic image is done.

B. Image pre-processing:

In this the pre-processing of the image is done. As a matter of first importance, the problems of the improvement in the image quality are secured, with the point of these representing as closely as possible the original one. Also, it is here where the computerized process of a software tool actually begins, the problem in the detection and treatment of the

“noise” is secured, which is used to show up in this sort of images, for example hair, bubbles, flashes, shadows, ink marks in the skin, electronic marks (generally computerized identifiers or copyright data), black frames and devices and rulers to measure.

C. Skin lesion segmentation:

The skin lesion segmentation is done. Constantly, it is embraced in an automated way. There exist semi-automated systems in which the expert is permitted to intercede in this stage, presenting information for the segmentation improvement.

D. Detection and characterization of indicators:

The automated identification and characterization of the picked indicators to attempt the diagnosis.

E. Diagnosis:

On the basis of the medical algorithm, the quantitative count of the malignancy level of threat is made.

III. SEGMENTATION TECHNIQUES

A lot of research has been done in the field of medical image segmentation process. Recently there are number of algorithms, every segmentation process is slightly different from another, but still we do not have any specific algorithm that is appropriate to all types of digital image which fulfil every objective [3, 4]. Therefore, medical image segmentation can be viewed where the known information is not adequate to allow the identification of a unique solution. The challenge in developing automatic Image segmentation method is in the selection of related parameters, algorithms, mathematical models [6]. The algorithms are based on either discontinuity principle or similarity principle. The main idea behind the discontinuity principle is to extract regions that differ in properties such as colour, texture, intensity, or any other image statistics. The idea behind the similarity principle is to group pixels based on common criteria [5].

A. Segmentation based on edge detection

Edge carries a lot of information about the various regions in an image. They provide an outline of the object. An edge is said to be a set of connected pixels that lies on the boundary between two regions that differ in grey value. These pixels on the edge are called edge points [18]. Edge detection technique is boundary identification where the information of the edge is detected and edge pixels with adjacent neighbour connectivity are tracked [6] Edge detection technique is a structural technique of the image segmentation process [17]. An edge detection operation is basically an operation to perceive important local changes in the intensity level of an image. The variation in intensity level is measured by gradient of the image [16].

B. Segmentation based on thresholding

Major approaches of segmentation are based on the pixel values. Thresholding is simple and popular technique for image segmentation [19]. Image segmentation by this technique is a simple but powerful method for segmenting images having light objects on dark background [15]. Thresholding technique is based on image space regions i.e. on characteristics of image [20]. It converts a multilevel image into a binary image. In this approach a threshold is applied to the image in order to distinguish the regions in distinct intensities. It chooses a proper threshold T , which divide image pixels into several regions and separate objects from background. Thresholding technique is used to determine an intensity value called as threshold, and then threshold splits the desires classes. The segmentation is done by grouping pixels with intensity greater than the threshold into one class, and all other pixels into another class[16]. But in imaging where the intensity non consistency or noise is present, in such cases it is difficult to use thresholding segmentation. [6]

C. Region based segmentation

A region of an image is defined as a connected homogenous subset of the image with respect to some criterion such as gray level or texture. The regions in an image are defined as group of connected pixels with similar properties. In this approach, each and every pixel is allotted to a particular object or region. On Comparing with edge detection method, segmentation algorithms are relatively simple and more immune to noise [23, 24]. Edge based method partition an image on the basis rapid change in intensity near edges whereas region based methods, partition an image regions that are similar according to some predefined criteria [25,26]. In the region-based segmentation, pixels which are corresponds to a particular object are grouped together and marked. Region-based segmentation uses appropriate thresholding techniques. The significant principles upon which it depends are value similarity and spatial proximity.

D. Segmentation based on clustering

Segmentation is a vital task in image analysis where you want to divide an image into two or several different regions of interest. Segmentation divides an image into separate regions containing each pixel with alike attributes. Clustering methods are mostly unsupervised approach that can be used to organize the data into groups which is based on resemblances of the individual data items. Most of the clustering algorithms do not rely on assumptions which are common to conventional statistical methods, for example the underlying statistical distribution of data, and so they are useful in conditions where little former knowledge exists. The potential of clustering procedures to disclose the underlying structures in data can be exploited in an extensive variety of applications, such as image processing,

classification, pattern recognition, modeling and identification. Clustering is essentially an easy process for categorizing objects or patterns in such a way that samples of the same group are more alike to one another than samples which belong to different groups. The main goals of clustering are compressing data, gaining insight into data which includes identifying salient features, detecting anomalies, etc.), classifying data, and clustering (Fuzzy C-Means Clustering). In K-mean clustering one data belong to only one cluster and algorithm Fuzzy c-means (FCM) is a method of clustering in which it allows one piece of data to belong to two or more clusters. This method is developed by Dunn [13] and improved by Bezdek in 1981 [14]. These techniques are explained below.

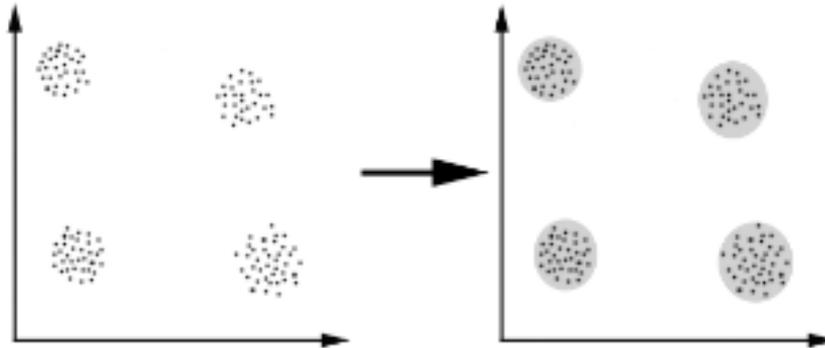


Fig. 4 Clustering [17]

1) K-mean clustering

Conventional hard clustering or K-means algorithm method is one of the simplest clustering methods. In this technique, it groups n pixels of an image into K number of clusters, where $K < n$ and K is a positive integer. Each point of the data set belongs to exclusively just one cluster. It is unsupervised learning algorithm. In the k-means algorithm firstly we have to define the k number of clusters. The k -cluster centre is selected randomly. Then distance between the each pixel to each cluster centres are considered. The pixel which is having minimum distance is allotted to a cluster otherwise it is moved to the next cluster and it is done in many iterations. Again each pixel is compared to all centroids. The process continuous until the centre converges. As a consequence, with this method the segmentation results are often very hard. In this every pixel of the image belongs to just one class. Though, for the image in numerous real situations, issues such as partial spatial resolution, overlapping intensities, poor contrast, and noise make this hard (crisp) segmentation a tough task. Hard clustering approaches are based on classical set theory, in which an object either belongs to or does not belongs to a cluster, which means an object belongs to only one cluster only. Hard clustering means dividing the data into a definite number of mutually exclusive subsets. [12]

2) Fuzzy clustering

Fuzzy clustering is an unsupervised method for the data analysis. Soft or Fuzzy clustering methods, in this the objects belong to several clusters having different degrees of membership. In many conditions, fuzzy clustering is more usual than hard clustering. The objects which are on the boundaries between numerous classes are not forced to completely belong to one of the classes, but somewhat are assigned membership degrees valued between 0 and 1 that indicate their partial membership [10]. The discrete nature of the hard partitioning causes difficulties with algorithms which are based on analytic functional, meanwhile these functional are not differentiable. In fuzzy clustering method it allocates each training vector a set of membership values, one for each cluster, rather than allocating each training vector to one and only one cluster. Since it is more accurate, several examination results have specified that it is superior to the hard clustering algorithm. A fuzzy set theory was then proposed, which produced the idea of fractional membership of belonging which is described by a membership function. Fuzzy clustering as a soft segmentation technique has been extensively studied and effectively applied in image segmentation. Fuzzy c-means (FCM) technique is one of the most popular method used in image segmentation because of its robust characteristics for ambiguity and can retain much more information than hard segmentation methods. In image segmentation the application of fuzzy theory holds more information from the original image instead of using other hard segmentation methods [11]. Below table shows the comparison of techniques.

E. Segmentation based on artificial neural network

A neural network is an artificial representation of human brain which is used to simulate its learning process. The network acquires the knowledge or information by altering its weights. ANN has many classifications depending configurations and methods of working. The main classification is to categorize ANN into supervised and unsupervised. In case of supervised learning, the network is trained by giving it the input and the corresponding output. In the unsupervised ANN the network is only given the input samples and it will adjust its weights so that it will have similar response for similar inputs. An artificial neural network is often known as a neural network [21]. It is a machine learning procedure. ANN works the way the human brain works. Artificial neural networks have been widely used to solve the problem of medical image segmentation. Neural network is based on simulation of life especially the human brain's learning process establishes a large number of parallel nodes. It comprises of neurons which are connected by weights. Each node can perform some basic computing. ANN is widely used to take decision based on complex and noisy data. ANN is used in medical images for the classification of data.

	Method Description	Advantages	Disadvantages
Edge Detection Technique	It is boundary identification method in which edge information is extracted and edge pixels with neighbour connectivity is followed.	It reduces the amount of data to be processed and therefore filter out information that may be less relevant.	1) This technique is not suitable for the images in which there are too many edges. 2) It is not appropriate for image segmentation on its own because edge pixels defined on the bases of local intensity variation and it could not form close boundary or close curve. 3) Presence of noise affects the performance in segmentation.
Thresholding Technique	It is applied to the image to distinguish region with distinct intensities. It is a method to convert gray scale to binary.	It is useful when the objects are lighter than background.	1) It is not suitable in the images where non uniformity occurs. 2) It is highly sensitive to noise. 3)It is not suitable with images having broad valleys.
Region Based Technique	This method segments the image into various regions having similar characteristics.	1) It works in real-time applications. 2) Splitting and merging of image gives better results 3) Less sensitive to noise.	It is a expensive method in terms of time and memory.
Fuzzy Technique	Clustering segments the image in such a way samples of the same group are more alike to one another than samples which belong to different groups	It is useful in real time application because it uses membership functions to give better results.	The determination of fuzzy membership is not easy.
Neural Network Technique	This method is based on the simulation of learning process for decision making.	In this complex programs are not required.	1) More Wastage of time during trainig. 2) Initialization may affect the result.

IV. CONCLUSION

Skin cancer is one of the deadly types of cancers in humans. With the enhancement in technologies, early detection of skin cancer is possible. In this review paper, various image segmentation methodologies are explained briefly for digital dermoscopy images to detect malenoma. These methods are very important for the identification of malignant malenoma. Image segmentation is used in medical science to detect the region of interest i.e. lesions , locate tumor and other abnormalities from medical images. The last section of this paper shows the comparison between all available segmentation techniques.

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