Volume 5, Issue 5, May 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

A Review on Automatic Diagnosis of Skin Lesion Based on the ABCD Rule & Thresholding Method

Harpreet Kaur
Student, Haryana Eng. College
Haryana, India

Aashdeep Singh
Asst. Prof. Haryana Eng. College
Haryana, India

Abstract—Human Cancer is one of the most dangerous disease which is mainly caused by genetic instability of multiple molecular alterations. Among many forms of human cancer, skin cancer is the most common one. Basically, there are two types of skin cancer named as malignant melanoma and non-melanoma which can be more dangerous if not treated earlier. Therefore, early finding of skin cancer can reduce mortality and morbidity of patients. To identify skin cancer at an early stage we will study and analyze them through various techniques named as segmentation and feature extraction. Both of these images are used to analyze different digital images appropriately. Based on the experiment, a result will be computed.

Keywords—skin cancer, melanoma, non-melanoma, feature extraction, segmentation

I. INTRODUCTION

Human Cancer seems as a dangerous disease which is caused mainly by genetic instability and accumulation of multiple molecular alternations. There are many types of cancer among which skin cancer are most common. There are two main types of skin cancers named as name malignant melanoma and non-melanoma.

Non melanoma skin cancer (MMSC) is the most dangerous form of cancer mainly found in light-skinned population. It can be fatal if not treated at early stage. We all know well that early detection and treatment of skin cancer can reduce the mortality and morbidity of patients.

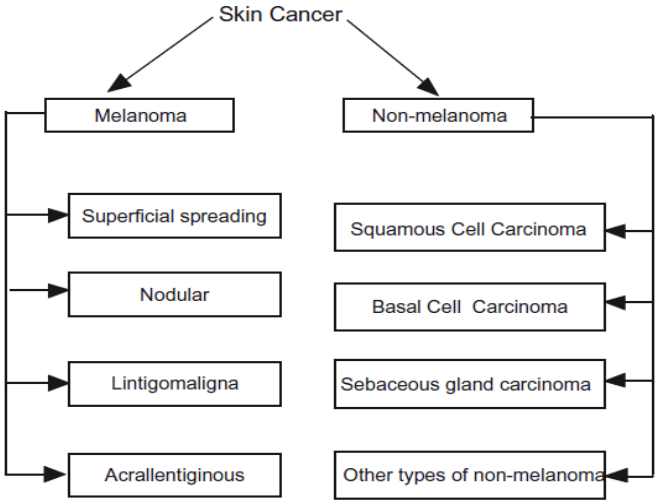

Figure1: Classification of skin cancer

Therefore, to detect skin cancer at very early stage Digital Dermoscopy is considered as one of the most effective weapon which is used to identify and classify skin-cancer. It is non-invasive in vivo technique, assists the clinician in melanoma detection in its early stage. This also includes dermoscopy, total body photography, , automated diagnostic system and reflectance confocal microscopy.

Computer technology played a vital role in medical field. This serves as a medical decision support widely spread and pervasive across a wide range of medical area, such as- gastroenterology, cancer research, hart diseases, brain tumours etc.

Skin cancer detection through image processing

As per recent research it is possible to recognize skin cancer from images using supervised techniques such as artificial neural networks and fuzzy systems as well as with feature extraction techniques. There are also many other techniques, names as k-nearest neighbours (k-NN) that also group pixels based on their similarities where each feature image can be used to classify the normal/abnormal images.

Therefore, to detect skin cancer at early stage, image processing method is used. Image processing is non-expensive technique. Image processing is any form of signal processing for which the input is an image, such as a photographer video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. An image-processing technique involves treating the image as a two-dimensional signal and applying standard signal-processing techniques to it.

Image processing are computer graphics and computer vision. In computer graphics, images are made manually from physical models of objects, environments, and lighting, from natural scenes. Image Processing forms core research area within engineering and computer science disciplines too.

To identify the edges of an object in an image scene is an important aspect of the human visual system; it provides information on the basic topology of the object which is used to obtain an interpretative match. Or we can say that, the segmentation of an image into a complex of edges is an important concept for object identification. There are many other processing methods that can be applied for this purpose. But our main purpose is to decide which object boundary each pixel in an image falls within and which high level constraints are necessary.

In detection of skin cancer through image processing, segmentation plays most important role for analyzing image properly as it affects the accuracy of the subsequent steps. Proper segmentation is not an easy task because of the great verities of the sizes, lesion shapes, and colors along with different skin types and textures.

Although, some lesions have irregular boundaries where as in some cases there is smooth transition between the lesion and the skin. In order to deal with this problem, several algorithms have been proposed. They are classified as thresholding, edge-based or region-based methods. There are three methods of segmentation:

- Otsu's method.
- Gradient Vector Flow (GVF)
- Colour Based Image Segmentation Using K-mean Clustering.

Otsu's Method- Otsu's is an optimal for thresholding objects from the background. It is based on a discriminate analysis which is used to partitions the image into two classes. For example- in given image, represented in L gray levels {0,1,2,……L},this method partitions the image pixels into two classes C0={0,1,2……t} & C1={t+1,t+2……..L-1}. Consider the number of pixels in the i_{th} gray level is n_i, where n is the total number pixels in an image. The probability of occurrence of gray level is given by:

$$p_i = n_i / n$$

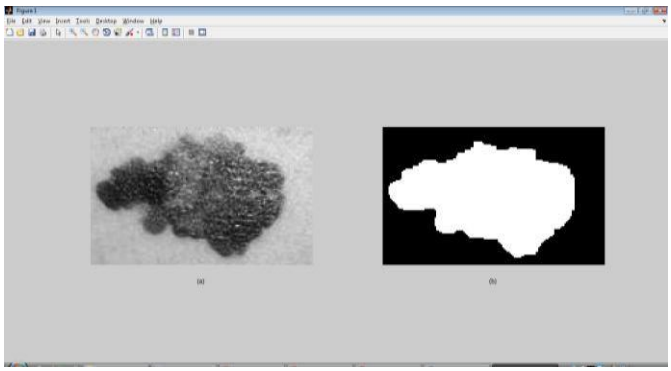

Figure 2:a) grayscale version of RGB, b) segmented image after applying Otsu method

This is one of the efficient methods of thresholding gray level images. This method can also be used in separating an image into two classes where two types of distinct classes exist in the image.

Gradient Vector Flow (GVF)- This is one of the most popular algorithms which is used in many medical imaging problems. The boundary of object is approximated by an elastic contour X(s) =(X(s), Y(s)), S [0, 1] which is initialized by the user or heuristic criteria in the image domain. After this elastic contour is modified as per the differential equation.

$$dx_{(s,t)}/d_t = F_{int}\ (X_{(s,t)}) + V_{int}\ (X_{(s,t)})$$

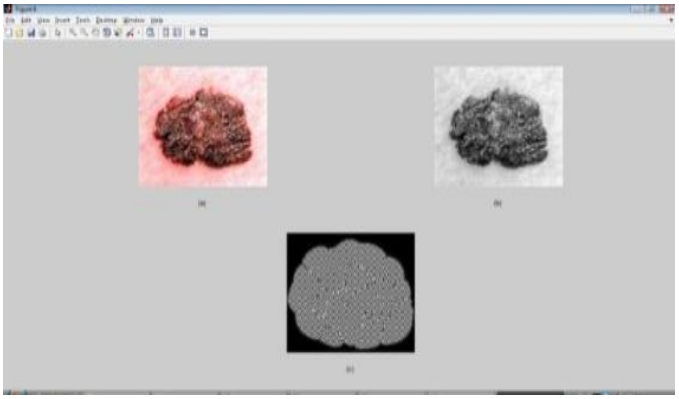

Figure 3: a) original RGB image, b) gray scale version of the RGB image, c) segmented image after using GVF method

The GVF field is a regularized version of edge gradient or image that allows long range attraction of the contour against the object boundary.

Colour Based Image Segmentation Using K-mean Clustering- The technique of Image segmentation techniques is classified into following basic concepts:

- Pixel oriented,
- Contour-oriented,
- Region-oriented,
- Model-oriented, and
- Colour-oriented and
- Hybrid.

The segmentation of image on the basis is a difficult operation in image analysis and also in many computer vision, image interpolation, and pattern recognition system. The performance of colour segmentation significantly affects the quality of an image understanding system. The segmentation process is categorized into two stages named as- Enhancing colour separation of medical image using decorrelation stretching is carried out After that the regions are grouped into three classes with the help of k-mean clustering algorithm.

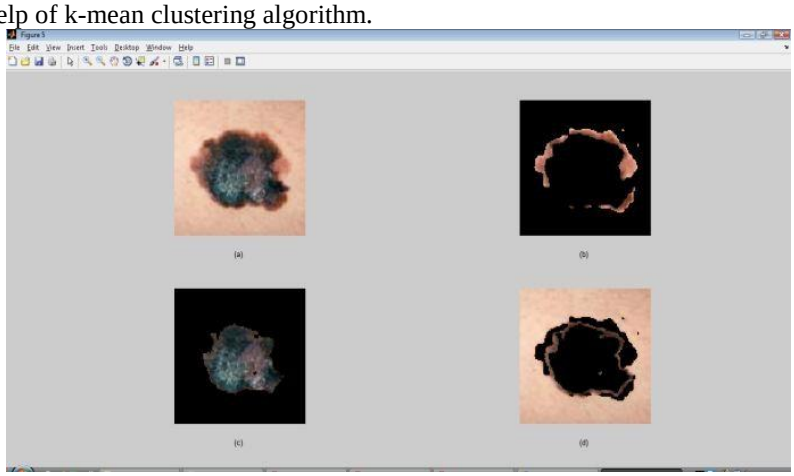

Figure 4: a) RGB image, b) object in cluster 1, c) objects in cluster 2, d) objects in cluster 3.

Through this two step process, we can reduce the computational cost which avoids feature calculation for every pixel in the image.

FEATURE EXTRACTION

In order to diagnose skin lesion automatically we will follow feature extraction process. A process is based on the rule i.e. ABCD-rule of dermatoscopy. ABCD stands for asymmetry, colour, variation, border structure and dermatoscopical structure which is also called diameter of the lesion. This process defines the basis for a diagnosis by a dermatologist

Asymmetry

We can easily understand the aspect of shape with the help of symmetry which plays an important role in pattern analysis. In case of symmetric pattern, we need one half of the pattern along the axis of symmetry. If in a case a pattern part is missing or noisy then with the help of symmetry we can complete the pattern or rid the pattern of noisy. The degree of symmetry is determined using two values of asymmetry feature i.e. Asymmetry Index (AI) and Lengthening Index. Asymmetry Index is calculated using equation:

$$AI=\Delta A/A*100$$

Where, A= Area of the total Image. = Area difference between total image and lesion area.

Border Irregularity

To determine border irregularity, we will follow many different measures like: compactness index, fractal index, edge abruptness, pigment transition.

Colour Variation

Melanoma is characterized into six different colours named as white, red, light brown, dark brown blue-grey and black. The variations in colour represent the early sign of Melanoma. As melanoma cells grows in grower pigment, thus they are colourful around brown, or black which depends on the production of the melanin pigment at various depths in the skin. The Colour descriptors are mainly statistical parameters which are calculated from different colour channels, such as average value and standard deviation of the RGB or HSV colour channel. The variation in colour of the RGB image has been calculated with the help of HSV channel.

Diameter:

The tendency of Melanoma growth is much larger than common moles, and having diameter of 6mm. As the shapes of Melanoma changes thus we need to find the diameter from all the edge pixels to the pixel edge via midpoint and averaged.

II. LITERATURE SURVEY

The various approaches used for the automatic diagnosing and prevention from Skin cancer using image processing and are described below:

A. Skin cancer detection using Feature extraction

The use of image processing for diagnosing skin lesion is a non-invasive technique. There is a huge interest in the concept of automatic analysis of image using image processing; both of these methods provide quantitative information regarding a lesion, relevant for the clinical, and as a standalone early warning tool. In order to identify skin cancer at an early stage without performing any digital images, skin biopsies of melanoma skin lesions have been investigated. This can be achieved through feature extraction, considered as an essential-weapon to analyse an image appropriately. For this, different digital images have been analysed on the basis of unsupervised segmentation techniques. After this, Feature extraction techniques are applied on segmented images. Then, a comprehensive discussion has been explored on the basis of obtained results.

B. Developing a prototype capable of segmenting skin lesions in dermoscopy images

Our aim is to develop a prototype which is capable of segmenting skin lesions in dermoscopy images and then classify them on the basis of visual characteristics, especially in detecting melanomas and then, separate them from other lesions. For this work ABCD rule is taken as a starting point. The rule is based on 4 visual features, for which an algorithm was developed to measure and quantify them.

The model is categorized into three distinct stages, named as :

1) Segmentation
2) Feature extraction
3) Classification

Image classifications are done through a supervised method named as- thresholding method, a k-nearest neighbour's classifier and a Support Vector Machines classification.

C. Features extraction through digital image processing methods

From last many years, computer-vision-based diagnosis systems have been used in several hospitals and dermatology clinics, for early detection of skin cancer, and especially, the recognition of malignant melanoma tumour. For this, we review the state of the art in systems by installation, then use of visual features for skin lesion classification, and then methods for defining them. After this, describing extraction of features through digital image processes methods, i.e., segmentation, colour, and border detection and texture processing. This is done using most prominent techniques for skin lesion classification.

D. Generalizing model for automatic skin lesion diagnosing

For automatic diagnosis of skin lesion a generalizing model using supervised learning and MAP estimation is used to perform many common tasks. The model is applied to segment skin lesions, detect occluding hair, and then identifying the dermoscopy structure pigment network. Then, quantitative results have been obtained which is then compared to other specialized methods.

E. Skin lesion diagnosing with Smartphone's

Melanoma skin cancer diagnosed in less than 5% and if not diagnosed at early stage may lead to death. Therefore, we need convenient automated diagnosis of skin lesions and melanoma recognition at early stage of melanomas. For this, a prototype of an image-based automated melanoma recognition system on Android Smartphone's has been used. This system has of three major components, named as: image segmentation, feature calculation, and classification. This system is designed to run on a mobile device with a camera, for example Smartphone or a tablet PC. In this process, a skin lesion image is converted to a monochrome image for outline contour detection. Then, colour and shape features of the lesion are extracted and used as input to a kNN classifier.

F. Classification of the skin images

The detection of skin cancer at an early stage has the potential to reduce mortality and morbidity. There are two hybrid techniques for the classification of the skin images. These hybrid techniques consist of three stages, named as; feature extraction, dimensionality reduction, and classification. The purpose of first stage is to obtain the features related to image with the help of discrete wavelet transformation. The second stage is used for the features of skin images that have been reduced with the help of principle component analysis. Whereas, in the classification stage, two classifiers on the basis of supervised machine learning have been developed. The first classifier depends on feed forward back-propagation artificial neural network, whereas, the second classifier is based on k-nearest neighbour. These classifiers have been used for classification of subjects as normal or abnormal skin cancer images.

G. Early detection of skin lesion with computer aided diagnostic system

A huge increase has been observed in the number of melanoma skin cancer patients. Therefore, effective treatment is required for early detection of skin lesion. For this, a computer-aided diagnostic system has been developed to facilitate its early detection. For this, segmentation method and an analytical method has been used. Aim of methods to develop

an interface that can assist dermatologists in the diagnostic phase. In first step, a sequence of pre-processing is implemented for removal of noise and unwanted structures from the image. Next step is feature extraction which is followed by the ABCD rule that is used to make the diagnosis through the calculation of the TDV score. Here, three diagnoses are used, named as: melanoma, suspicious and benign skin lesion.

H. 7-point checklist for early detection of skin lesion

In order to automatically detect melanoma an image based system is implemented, serves as a support to clinicians. Detecting melanoma at early stage is one of the biggest challenges of dermatologic practice today. For this purpose, new diagnostic method, called the "ELM 7 point checklist", defines a set of seven features, on the basis of colour and texture parameters, that describe the malignancy of a lesion. Dermoscopy is an in vivo method used for the early diagnosis of malignant melanoma and the differential diagnosis of pigmented lesions of the skin.

A table below includes the method used, author and year or publication as well as features of each method and findings.

METHOD	**AUTHOR & YEAR**	**FEATURS**	**FINDINGS**
I. Skin cancer detection using Feature extraction	Md.Amran Hossen Bhuiyan, Ibrahim Azad, Md.Kamal Uddin In 2013	Use of feature extraction method to analyze image appropriately.	It is necessary to detect skin cancer fast and effectively for highest cure rates. For this is four stage analyses. But if it goes through three stage analyses will show erroneous result.
II. Developing a prototype capable of segmenting skin lesions in dermoscopy images	Luís Filipe Caeiro Margalho Guerra Rosado	Classification of images using various methods such as segmentation. ABCD rule is used as a starting point	The method which has been used shown satisfactory result but still some improvement is needed to eliminate several artifacts such as thick hairs.
III. Features extraction through digital image processing methods	Ilias Maglogiannis In 2009	Use of digital image process method for extraction of features	Many systematic trials are needed.
IV. Generalizing model for automatic skin lesion diagnosing	PaulWighton,TimK.Lee, HarveyLui,DavidI.McLean,andM.StellaAtkins In 2011	Make use of generalizing model as well as MAP estimation for performing many common tasks.	Provide sufficient result and perform competitively.
V. Skin lesion diagnosing with Smartphone's	Kiran Ramlakhan and Yi Shang In 2011	Shape and colour features of the lesion are extracted and used as input to a kNN classifier.	Provides good accuracy
VI. Classification of the skin images	Mahmoud Elgamal In 2013	Make use of two hybrid techniques for the classification of the skin images. Reduce mortality and morbidity	Provides an efficient result still needs improvements in specificity and accuracy
VII. Early detection of skin lesion with computer aided diagnostic system	Nadia Smaoui In 2013	Removal of noise and unwanted structures from the image.	Need some improvements as accuracy of system is 92%

VIII. 7-point checklist for early detection of skin lesion	Apoorva Raikar, Asst.Prof. S. P. Sangani, Asst.Prof.K D.Hanabaratti In 2013	Make use of seven features which describe the malignancy of a lesion	System is not much experienced. Therefore, some more trials are expected.

III. CONCLUSION

Skin cancer is one of the most frequent types of cancer worldwide. Basically, there are two types of skin cancer called malignant melanoma and non-melanoma. Non melanoma skin cancer (MMSC) is the most dangerous form of cancer mainly found in light-skinned population. The aim of our work is to identify skin cancer at an early stage with the help of two techniques i.e. feature extraction and segmentation. Generally, there are four stages named as- segmentation, feature extraction, acquisition and classification. Among all of these segmentation is one of the most effective techniques. It is classified into three categories i.e. thresholding, edge contour-based and region based. We will use thresholding method to achieve better result. This method is based on otstu method which automatically detects the image. This method provides better result with a good contrast between lesion and skin.

REFERENCES

[1] Md.Amran Hossen Bhuiyan, Ibrahim Azad, Md.Kamal Uddin, *Image Processing for Skin Cancer Features Extraction*, International Journal of Scientific & Engineering Research Volume 4, Issue 2, February-2013

[2] Luís Filipe Caeiro, *Automatic System for Diagnosis of Skin Lesions Based on Dermoscopic Images.*

[3] Ilias Maglogiannis, *Overview of Advanced Computer Vision Systems for Skin Lesions Characterization*, IEEE Transactions on information technology in biomedicine, vol. 13, no. 5, September 2009

[4] Paul Wighton, Tim K. Lee, Harvey Lui, David I. McLean, and M. Stella Atkins, *Generalizing Common Tasks in Automated Skin Lesion Diagnosis*, IEEE Transactions on information technology in biomedicine, vol. 15, no. 4, July 2011

[5] Kiran Ramlakhan and Yi Shang, *A Mobile Automated Skin Lesion Classification System*, 2011 23rd IEEE International Conference on Tools with Artificial Intelligence

[6] Mahmoud Elgamal, *Automatic skin cancer images classification, (IJACSA)* International Journal of Advanced Computer Science and Applications, Vol. 4, No. 3, 2013

[7] Nadia Smaoui, Souhir Bessassi, *A developed system for melanoma diagnosis*, International Journal of Computer Vision and Signal Processing, 3(1), 10-17(2013)

[9] Apoorva Raikar, Asst. Prof. S. P. Sangani, Asst .Prof. K D. Hanabaratti, *Diagnosis of Melanomas by Check-list Method*, July 4 - 6, 2013,

