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Review of Challenges Faced in Automated Diagnosis of Skin Lesions in Dermoscopy Images

Ms. J. Jacinth Poornima
Karunya University
Dr. J. Anitha
Karunya University
Asha Gnana Priya.H
Karunya University

ABSTRACT

For few decades, the skin lesions are variously classified as a very challenging task due to the contrast, huge sub variations of skin lesions between melanoma and non-melanoma lesions. Melanoma is the deadliest form of skin cancer. Incidence of death rates have been increasing especially among white skinned humans, but survival of fittest are at high risk. This paper critically reviewed the existing state of art techniques available for melanoma detection through digital image processing methods, i.e., skin images, image enhancement, image segmentation, feature extract, classifier, skin lesions abnormalities, performance analysis. We have compared and enlisted recentperformance analysis which will enable us to compare the difference in detection of melanoma in dermoscopy images. Thus, the identified scope of this paper also gives suggestions for further improve the accuracy.

Keywords

Dermoscopy, preprocessing,image segmentation, skin lesion classification.

INTRODUCTION

Malignant Melanoma is one of the most rapidly increasing cancers all over the world, with the estimated new cases of 76,380 and estimated death of 10,130 in the United States in 2016 [1]. It develops when skin cells multiply rapidly because of mutations in their DNA caused by UV exposure. Melanomas originate in the pigment-producing melanocytes in the basal layer of the epidermis; they often resemble moles and are generally black or dark brown. Melanoma accounts 75% of death associated with skin cancer. Dermoscopy assessment is widely used in the diagnosis of melanoma and obtains much higher accuracy rates than evaluation by naked eyes. Melanoma accounts for 1-3% of all malignancies. It has an increasing incidence worldwide. It is commonly seen in the lower extremities and metastasizes to the draining lymph nodes. Other common primary sites are trunk/head and neck. The most common sites of metastases include inguinal lymph node, lung, brain, liver, bone marrow and intestine. Many studies from abroad have shown the most consistent and useful features of melanoma on fine-needle aspiration cytology (FNAC) specimens.There are not many cytological studies describing the morphological spectrum of melanoma in India. Hence, this study was undertaken to try in describing the various cytomorphological features of melanoma.

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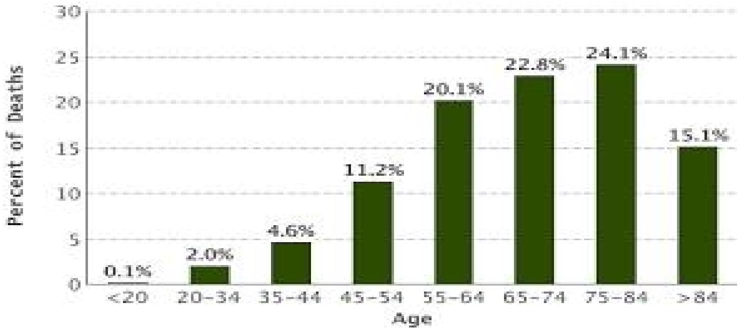

Graph No 1 – Graphical Representation of percentage of death with respect to the age factor.

BLOCK DIAGRAM

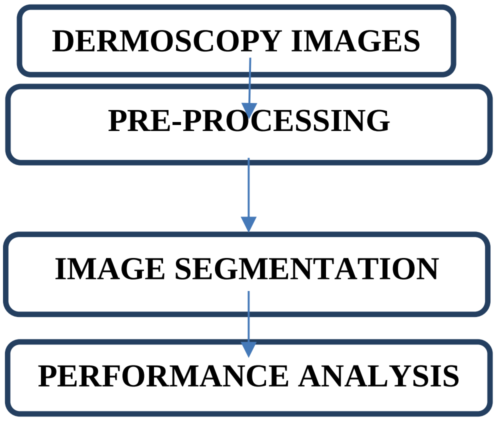

Figure 1: A general block diagram of melanoma in dermoscopy images.

DERMOSCOPY IMAGES

The increasing incidence of melanoma has recently promoted the development of computer-aided diagnosis systems for the classification of dermoscopic images. The PH² dataset has been developed for research and benchmarking purposes, in order to facilitate comparative studies on both segmentation and classification algorithms of dermoscopic images. PH² is a dermoscopic image database acquired at the Dermatology Service of Hospital Pedro Hispano, Matosinhos, Portugal. This image database contains a total of 200 dermoscopic images of melanocytic lesions, including 80 common nevi, 80 atypical nevi, and 40 melanomas. The PH² database includes medical annotation of all the images namely medical segmentation of the lesion, clinical and histological diagnosis and the assessment of several dermoscopic criteria (colours; pigment network; dots/globules; streaks; regression areas; blue-whitish veil).

IMAGE ENHANCEMENT / PRE-PROCESSING

Image pre-processing before analysis of any image set cantake place, pre-processing should be performed on all theimages. This process is applied in order to make sure that all the images are consistent in desired characteristic. When working with dermatoscopic images, pre-processing can cover number of features like: image illumination equalization, color range normalization, image scale fitting, or image resolution normalization. This can be dependent on defined prerequisites and methods applied in post processing. An example of elementary operation such as image normalization is the resolution matching. Assuming that the image size in pixels is given, and all images are in the same proportion (e.g. aspect ratio of 4:3), it is easy to find the images of smallest resolution and then scale the larger images to match the size of the smallest one. This operation allows calculating the features like lesion dimensions, lesion border length and lesions area coverage. we are using Dull-Razor filter to remove the noise and is explained as follows:1) It identifies the dark hair locations by a generalized grayscale morphological closing operation, 2) It verifies the shape of the hair pixels as thin and long structure, and replace the verified pixels by a bilinear interpolation, and 3) It smooths the replaced hair pixels with an adaptive median filter.

IMAGE SEGMENTATION

The patch of skin lesion in a dermoscopic image, is a single bounded region that is differentiated from the normal surrounding skin by the variance of colour and texture, this determines the region of interest[11]. To segment these skin lesions from dermoscopy images are further classified as melanoma and non-melanoma so that the classification stage can extract more specific and representative features within the lesion regions instead of performing it in the whole dermoscopy images. [2]The edge of the segmented melanoma region is called as the border or boundary, also provides features for use in the analysis of the lesion[17].Correct identification of the non-melanoma area, ignoring artefacts present in some images, also provides a region of normal skin for calculating relative colours and other useful features [18] [19].The absence or presence of streaks in a skin lesions, by further analysing the appearance of detected streak lines, and performing a three-way classification for streaks, Absent, Regular, and Irregular, in a pigmented skin lesion. Orientation estimation andcorrection is applied to detect low contrast and fuzzy streaklines and the detected line segments are used to extract clinicallyinspired feature sets for orientation analysis of the structure.A graph representation is used to analyse the geometricpattern of the structure over the lesion with new features designedto model the distribution and coverage of the structure.These results demonstrate that the proposed approach can locate,visualize, and classify streaks as Absent, Regular, and Irregularin dermoscopy images. Therefore, it can be used in computer-aided melanoma diagnosis using scoring methods. Furthermore,since the proposed method locates streaks and providesa qualitative analysis, it can be used to highlight suspiciousareas for experts’ diagnosis and for visualization and trainingpurposes.The method has been successfully applied in thespecific caseof automatic detection and classification of streaks, which arerepresented by linear radial patterns. These oriented patterns,produced by propagation, accretion, and deformation in radialphase, are common in nature and in different fields of computervision, and they are an important class for visual analysis.In future work, the segmented line segments will be investigatedmore locally to deal with this problem more accurately, bycarefully analysing the lesion shape and fitting multiple ellipses.In such cases, as many streaks as possible would be captured[7].

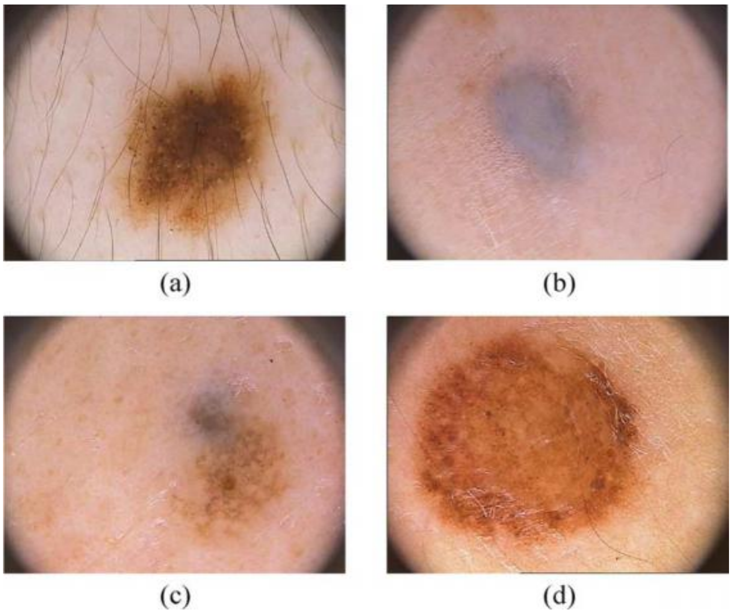

Fig. 1. Difficulties of dermoscopic images; (a) presence of hair; (b) smooth transition between lesion and skin; (c) multiple coloured lesions; and (d) specular reflections [4].

PERFORMANCE ANALYSIS

Performance measures generally used for assessing the segmentation and classification of dermoscopy images are Accuracy (AC), Sensitivity (SE), Specificity(SP). These evaluation criteria are used to calculated for various dermoscopy images and then average of each criterion on the whole testing dataset to get the final results. The criteria are defined as:

$$AC = \frac{N_{tp} + N_{tn}}{N_{tp} + N_{fp} + N_{fn} + N_{tn}} \quad (1)$$

$$SE = \frac{N_{tp}}{N_{tp} + N_{fn}} \quad (2)$$

$$SP = \frac{N_{tn}}{N_{tn} + N_{fp}} \quad (3)$$

Where $N_{tp}, N_{tn}, N_{fp}, N_{fn}$ denote the number of true positive, true negative, false positive and false negative, respectively and they are all defined on the pixel level.

S.NO	PAPER	DATABASE	NO.OF IMAGES USED	METHODS	PERFORMANCE MEASURE OF SEGMENTATION		
					SE%	**SP%**	**AC%**
1	FengyingXie [3]	Xanthous Race	240	SGNN	95	9 3.75	94.17
		Caucasian Race	240	SGNN	83.33	95	91.11
2	Lequan.Yu [2]	ISBI 2016 Skin lesion analysis towards melanoma detection dataset	900	FCRN	54.7	93.1	62.4
3	Yading Yuan[5]	PH2	900	DCNN	92.6	97.1	96.3
4	Amir Reza Sadri [10]	-	30	1.FGWN	94.34	99.84	99.67
				2.NN	93.36	99.75	99.55
				3.FBSM	88.41	99.66	99.30
				4.GVF	83.96	99.37	98.85
				5.AT	83.33	99.28	98.74
5	Jeffrey Glaister [6]	Dermquest Database	126	1.TDLS	91.2	99	98.3
				2.Otsu-PCA	79.6	99.6	98.1
				3.Otsu-RGB	93.6	80.3	80.2
				4.Otsu-R	87.3	85.4	84.9
				5.L-SRM	89.4	92.7	92.3

Table No 1. The classification and segmentation performance of different methods which are analysed from various papers

CONCLUSION

In this study, the performance analysis gives us the clear picture of how the image segmentation can be done for the different database along with the different methods that are used. The further process can be refined by using optimization techniques to get better results in comparison to the similar previous studies.

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