AUTOMATED DETECTION AND SEGMENTATION OF VASCULAR STRUCTURES OF SKIN LESIONS: A SURVEY OF EXISTING TECHNIQUES

Er. Komal Sharma

University Institute of Engineering, Computer Science & Engineering,
Chandigarh University, Mohali, India

Er. Sanjay Madaan

University Institute of Engineering, Computer Science & Engineering,
Chandigarh University, Mohali, India

ABSTRACT

Skin cancer accounts to be a standout amongst the most prevalent types of carcinoma ailments, particularly among Caucasian offspring and pale-skinned persons. Specifically, the melanocytic dermis lesion are conjectured as the most lethal among three pervasive skin carcinoma ailments and the second most communal type amongst youthful grown-ups who are 15-29 years old. These apprehensions have impelled the requirement of automated systems for the diagnosis of skin carcinomas within a limited time frame to reduce unnecessary biopsy, proliferating the momentum of diagnosis and giving reproducibility of indicative outcomes. In this survey paper a brief overview of automated detection and segmentation of vascular structures of skin lesions is presented

Keywords: Vascular structures, Skin lesion segmentation, Medical image analysis, Melanoma skin, automated diagnosis.

Cite this Article. Er. Komal Sharma and Er. Sanjay Madaan, Automated Detection and Segmentation of Vascular Structures of Skin Lesions: A Survey of Existing Techniques, *International Journal of Computer Engineering and Technology*, 10(1), 2019, pp. 25-31.

<http://iaeme.com/Home/issue/IJCET?Volume=10&Issue=1>

1. INTRODUCTION

1.1. SKIN CANCER

Skin being the largest body organ acquiring nearly 20 sq. feet area, provides protection from micro-organisms and elements, assists in regulating the temperature of body and allows the sensitivity of cold, warmth and touch.

The two foremost layers comprised by the skin are:

1. Epidermis and
2. Dermis

Epidermis is a stratified squamous epithelium, that provides protection from outside belligerence such as UV radiations, infections, water loss and injuries. Melanocytes, located in the epidermis are responsible for producing the natural pigment called Melanin, which grants skin its colour.

Epidermis comprises of 4 types of cells:

- ❖ Keratinocytes: These constitute about 95% of the cells in the epidermis and are the steering force for continuous resumption of the skin. They sustain an expedition from basal layer to stratum corneum, fundamentally due to the ability to differentiate and dissipate. Amid this, the daughter keratinocytes so produced by fission in the basal layer (basal cells) move to the next layers transfiguring their morphology and differentiation. And as a result of this transformation, the flattened cells not having nuclei containing keratin forms the outermost layer known as Corneocytes. At the end, these corneocytes lose their cohesion and dissipate from the surface in the shedding process called Desquamation.
- ❖ Melanocytes: These are dendritic cells present in the basal layer of epidermis. They allocates melanin packages to the keratinocytes to impart colour to skin and hair.
- ❖ Langerhans cells: These are also dendritic cells just like melanocytes, responsible for the recognition of antigens which penetrates the epidermis and for carrying those antigens to the lymph nodes.
- ❖ Merkel cells: These are presumably gleaned from keratinocytes which in response of touch acts as mechano-sensory receptors.

Figure 1 Anatomy of the skin [1]

This paper presents the existing trends in automated detection and segmentation of vascular structures of skin lesions. Specifically, part 2 presents the literature survey (background survey) of existing techniques in this area. The survey based result of existing work is cover in part 3 and we conclude with discussions on current challenges and future trends in part 4.

2. BACKGROUND SURVEY

In this section, we present the survey of existing work for detecting and segmenting the vascular structures of skin lesions using different techniques.

Pegah Kharazmi et al. [2] proposed a novel framework for detecting and segmenting cutaneous vasculature from dermoscopic pictures and then extricating the vascular features so as to explore them for classification of skin cancer. The authors used K-means clustering; and haemoglobin component was then clustered into normal, pigmented, and erythema clusters. Then at erythema cluster, the shape filters at different scales were applied. Afterwards Otsu thresholding was applied that generated a vessel mask. On comparing this proposed framework with other methods, the top performance of 96.5% was attained by the proposed framework in terms of distinguishing the benign lesions from the Basal cell carcinomas.

Lequan Yu, et al. [3] anticipated a method for recognition of melanoma by taking the advantages of very deep CNNs. This method guarantees that the developed networks seeks benefits from the enhanced performance attained due to the increased depth of network. Afterwards, The authors built a FCRN for precise segmentation of skin lesion and additionally improved its abilities by integrating a contextual information approach, thereby enabling the classification network for extricating more particular and suitable features on the basis of segmentation outcomes rather than the entire dermoscopic image.

Yading Yuan et al. [4] presented an automated system by utilizing deep convolutional neural networks along with Jaccard distance for segmenting lesion. The authors implemented various strategies for handling the obstacles that comes up amid training a deep network in the presence of restricted training data. They developed a loss function on the basis of Jaccard distance for enhancing the performance of segmentation. The outcomes of the proposed approach depicted how robust it is when it comes to several artifacts of image and image capturing conditions while requiring least befor and after processing.

N. C. F. Codella et al. [5] proposed a Deep learning based model for melanoma recognition by segmenting and classifying the dermoscopic images of skin. The authors evaluated their work on the biggest publically available melanoma dataset. The performance was significantly improved and higher accuracy was attained by the proposed system.

Fengying Xie et al. [6] developed a framework for classifying melanoma by employing a neural network based model on digitally acquired dermoscopic images. Initially they extricated the lesions using SGNN, then the descriptive features were extricated and finally by using a neural network based classifier, the objects of lesion were classified. New lesion border features were also developed for effectual characterization of the irregularities present in the border for both the cases of complete and incomplete lesion images. The outcomes illustrated the enhanced classification accuracy attained due to the development of new border features and proposed model of classifier.

Euijoon Ahn and Ashnil Kumar [7] proposed saliency-based segmentation of skin lesion by means of detecting the background in the dermoscopic images. The authors then compared their proposed approach with the other existing similar methods and outcomes showed the superiority of the proposed method over the other methods in terms of performance.

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C. Benazzi et al. [8] proposed a model angiogenesis in spontaneous tumors and implications for comparative tumour biology. They proposed a comparative study on tumour analysis using the different techniques. From the survey they founded that, the tumour classification accuracy may be high if the training and classification of system will be proper. The training of a classification system is totally depending on the feature sets so need to an optimization algorithm with classification system.

B. Cheng et al. [9] proposed automated analysis of telangiectasia in dermoscopic images by using adaptive critic design. The authors chose detecting BCC instead of detecting vessel as their end goal. Even though detecting vessel is characteristically easier, detection of BCC has possible direct medical applications. Minor BCCs can easily be detected with the help of dermoscopy and possibly detectable via the automatic methods described in this study. Experimental outcomes yielded a high diagnostic accuracy of 84.6% by using the ADHDP approach, resulting in improvement of 8.03% over a standard MLP approach.

Based on the survey we conclude some important point which helps to short out existing problem. The tabular representation of survey is given in table I.

Table I Survey of existing work based on findings and future scope

Authors	Proposed Techniques	Findings	Future Scope
Pegah Kharazmi [2017]	K-means clustering, Shape filters, and independent-component analysis (ICA)	By using K-means clustering algorithm to segment the Vascular Structures of Skin Lesions give better segmentation results.	Considering more skin colour clusters can improve the clustering accuracy.
Lequan Yu [2017]	Fully convolutional residual network for segmentation and deep convolutional neural networks for classification	With effective training Very deep CNNs can be employed for solving complicated medical image analysis problem.	Integration of probabilistic graphical model into the proposed network can enhance the discrimination capability.
Yading Yuan [2017]	Jaccard distance, pixel-wise classification for medical image segmentation and fully convolutional neural networks (FCNN)	FCNN is the better classier as compare to the other classifier because, FCNN is multiclass classifier and take less time as compare to the CNN	Segmentation performance can be improved by integrating the proposed method with Bayesian learning like CRF and other post-processing techniques.

N. C. F. Codella [2017]	A fully convolutional neural network based on U-Net architecture for segmentation.	U-net based segmentation is better selection of segmentation technique and by using this; efficiency of system is increased as compare to other technique.	Learning a joint pattern-disease classification model, other machine learning algorithms for additional performance gains, use of additional situational contexts that further improves the system performance.
Fengying Xie [2017]	Self-generating neural network based segmentation and combination of Fuzzy logic with BP Neural networks for classification purpose.	The classification accuracy improved by using the proposed border features and classifier model.	Designed model is relatively complex as it requires more space for storage and computation time. So this limitation can be sought in the future works.

3. SURVEY BASED RESULT

This section illustrate the survey of existing technique based on the results and comprehensive technique is better option to find out the better technique for automatically detecting and segmenting the vascular structures of skin lesions. The comparative analysis of results based on the table I is shown in the table II and figure 2.

Table II Comparison of accuracy

Authors	Accuracy (%)
Pegah Kharazmi [2017]	96.5
Lequan Yu [2017]	93.1
Yading Yuan [2017]	96.3
N. C. F. Codella [2017]	71.5
Fengying Xie [2017]	91.11

Figure 2 Comparison of accuracy

Figure 2 represents the comparative analysis of existing work based on the classification accuracy. From the figure we observe that the accuracy achieve by Pegah Kharazmi [1] is better than other author by using the K-means clustering with the concept of shape filters using ICA feature extraction technique.

4. CONCLUSION & FUTURE WORK

This survey paper discusses in details the various approaches for detecting and segmenting the vascular structures of skin lesions using different technique. For the detection and classification of skin diseases, segmentation of vascular structure of skin lesions is major task. So in this paper we presented a brief survey on the detection and segmentation technique with classifiers. From the survey we concluded that, the combination K-means clustering with the concept of shape filters using ICA feature extraction technique is better option.

In future, to minimize these types of problems from lesions detection and segmentation system, SURF descriptor along with optimization algorithm is best solution. In future work, Artificial Neural Network (ANN) is used as a classifier to train system based on SURF feature from the segmented region.

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