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A COMPREHENSIVE SURVEY ON AUTOMATIC SEGMENTATION AND CLASSIFICATION OF SKIN CANCER FROM DERMOSCOPIC IMAGES

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ABSTRACT

Skin cancer is defined as a preventive disease that spreads across the bloodstream of the human body. There is no possibility or methods to find out the exact reason for any type of cancer, but here is the cause of cancer such as tobacco consumption, bad diet, absence of physical activity, obesity, UV exposure and alcohol consumption. Malignant type of skin cancer is the deadliest form of skin cancer. It can be easily treatable if detected in early stages. Clinical as well as automated methods are being used for skin cancer diagnosis but computer aided diagnosis systems have great potential for early skin cancer detection. In this survey paper, a comprehensive survey on automatic segmentation and classification of skin cancer from dermoscopic images is presented to find out the better option regarding future research based on the current challenges.

KEYWORDS: Skin Cancer, Dermoscopic Images, Skin Lesion Segmentation, Pattern Recognition, Medical Image Analysis, Computational Intelligence, Automated Cancer Diagnosis.

1. INTRODUCTION

Skin is the one of the most biggest largest organ of the human body which covers almost area of body and it near to approximately 20 ft^2[1]. In the human body, the main role of the skin is to help to protect internal parts form unwanted things like ultraviolet rays, microbes and permits the sensations of touch, heat, and cold and it also help to regulate the temperature to entire body of human. The types of human skin layers are divided into three categories such as Epidermis, dermis and hypodermis as shown in Fig 1.

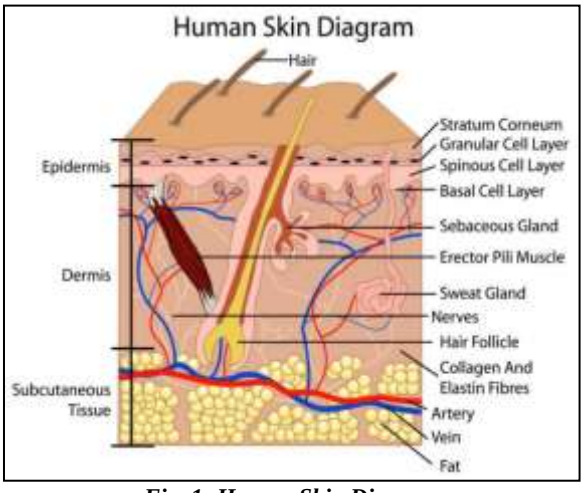

Fig. 1: Human Skin Diagram

The types of skin lesion are divided in main two parts named as:

- ***Benign Lesions:*** In benign lesions melanin deposits are normally found in the epidermis layer.
- ***Malignant Lesions:*** In malignant lesions, melanin is reproducing at a high abnormal stage.

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Malignant lesions are not life threatening till the Melanocytes and their associated melanin remains in the epidermis layer but when they penetrate into the dermis and leave deposits then the nature of the skin color change as shown in Fig 2. More than 100,000 new cases of skin cancer are diagnosed each year and around 2500 people died due to this fatal disease according to the British Skin Foundation (BSF) survey.

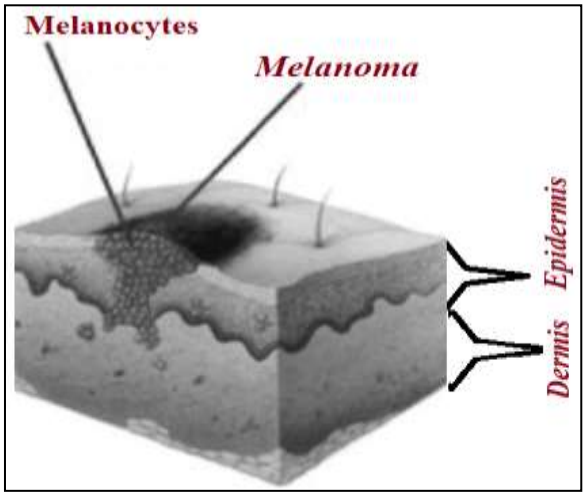

Fig. 2: Spreading of Melanoma and Melanocytes

Skin cancer is starts from the division cells initially, later on it becomes cancer, and it's a disease that begins in the skin cells [2]. The part of skin affected by cancer is known as the lesion [3]. There are different kinds of skin cancer like Melanoma is the most serious skin cancer other skin cancers are known as the non-melanoma skin cancer which includes:

- ***Basal Cell Carcinoma (BCC):*** BCC, now a day it becomes the most usual kind of skin cancer. It initiate in part of skin that are directly affected by sun rays, like face, head, neck, hands and arms. Any type of cancer initially small, shiny but this is not fixed it can initiate from any kinds. They grow very slow and sometimes distribute among other parts of the human body. Most of this type of cancer can be cured and treated, sometimes we can reappear after treatment, but this cancer typically spreads to other parts of the body. If it is not during a certain period of time, it is possible to extend the bone inside the body.
- ***Squamous Cell Carcinoma (SCC):*** The second most common form of skin cancer is this form of cancer that occurs throughout the upper part of the dermis with straight layers identified as squamous cells. Approximately 20% of skin cancers rise from these cells. It mainly caused by rays of sun and it can also be discovered on skin that has been burned, harmed by certain chemicals or immediately visible to x-rays. Usually it is found on the lips and skin around the mouth and anus, but it may also originate from several other body areas, including the genital region hair. Limited to 2%-5% of SCC spread across other areas of the body.
- ***Markel Cell Carcinoma (MCC):*** This cancer is rarely discovered and mostly appears on the bottom layer of the skin. These cells near the ends of the nerves help to touch the skin slightly. This cancer can become dangerous due to its fast growing nature or highly aggressive. It can be quite difficult to treat if it spreads across the skin. It starts in hormone-producing cells even through the skin and hair follicles. It also seen on sun-exposed area of skin like basal cell carcinoma. But any part of the body can start, mostly seen as solid, shiny globs that really don't hurt. One of the colors might be the lumps. Merkel cell cancer is also known as skin neuroendocrine or trabecular cancer.
- ***Cutaneous T- Cell Lymphoma (CTCL):*** Such a form of cancer occurs as key aspect of the immune system in the hemoglobin referred like the T-lymphocytes, these all are the white blood cells. Scaly patches or bumps are the reason for this cancer, this type of cancer is also known as lymphoma of skin, this is a non-Hodgkin lymphoma type. This cancer is generally slowly rising, that produce more than the many long duration of time. It can be categorized into two most prevalent kinds of mycosis fungoids and sezary syndrome.
- ***Kaposi Sarcoma (KS):*** It is a cancer that develops from the cells that line lymph or blood vessels. The abnormal cells of KS form purple, red, or brown blotches or tumors on the skin. These affected areas are called lesions. The skin lesions of KS most often show on the legs or face.

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This paper presents a comprehensive survey on automatic segmentation and classification of skin cancer from dermoscopic images. Section 2 of this paper presents the literate survey (background survey) of existing work for segmentation and classification of skin cancer from the dermoscopic images and section 3covers the experimental survey and we conclude with discussions on current challenges and future trends in section4 of paper.

2. BACKGROUND SURVEY

In this section, we present the survey of existing work based on the automatic segmentation and classification of skin cancer from dermoscopic images using different techniques. Dermoscopic is a popular in vivo non-invasive imaging tool that uses polarized light to aid dermatologists in examining pigmented skin lesions based on a set of morphological features. ***Pegah Kharazmi et al. [1]*** proposed a robotized discovery and division of vascular structures of skin injuries seen in dermoscopy with an application to basal cell carcinoma arrangement. They present a novel structure for location and division of coetaneous vasculature from dermoscopy pictures is presented and the further extricated vascular features are explored for skin malignant growth grouping. K-implies bunching is utilized by the creators with shape channels to group the erythematic group at various scales. Due the absence of optimization and classifier technique, the arrangement and division result isn't acceptable for therapeutic science research point of view on the grounds that there are heaps of non melanoma districts are consider as melanoma. ***Lequan Yu, et al. [2]*** presented computerized melanoma acknowledgment in dermoscopy pictures through extremely deep leftover systems. They proposed a novel technique for melanoma acknowledgment by utilizing deep convolutional neural systems (CNNs). This technique can guarantee that the proposed systems profit by the performance additions accomplished by expanding system depth. From that point forward, they develop a completely convolutional remaining system (FCRN) for accurate skin sore division, and further improve its capability by incorporating multi-scale logical data coordination conspire. This system empowers the characterization system to extricate progressively representative and specific features dependent on divided outcomes rather than the entire dermoscopy pictures, further reducing the deficiency of preparing information. The execution time and CNN and FCRN are high and it isn't acceptable in restorative science, so improvement need in the division phase. ***Yading Yuan et al. [3]*** proposed a programmed skin injury division utilizing deep completely convolutional systems with Jaccard separation. In this work, they proposed a completely programmed structure dependent on deep convolutional neural system for skin sore division on dermoscopic pictures. A few powerful preparing strategies were implemented to handle the difficulties that preparation a deep system may confront when just restricted preparing information is accessible. They structured a novel misfortune capacity dependent on the Jaccard separation to further lift the division performance however the division time is more and need to lessen the execution time in future work. The aftereffects of proposed work are unmistakably demonstrated that the proposed technique is strong to different picture curios and imaging securing conditions while utilizing least pre and post-processing. The proposed therapeutic picture division undertakings is better as compare to the next however just time complexity is significant disadvantage. ***N. C. F. Codella et al. [4]*** proposed novel deep learning groups for melanoma acknowledgment in dermoscopy pictures. They have proposed a system for the division and grouping of melanoma from dermoscopic pictures of skin. The strategy was assessed on the biggest public benchmark for melanoma acknowledgment accessible. The proposed work is applicable for direct picture during the grouping process and need to improvement in the pre-processing steps for further utilizations of non straight pictures. ***Fengying Xie et al. [5]*** proposed a melanoma order on dermoscopy pictures utilizing a neural system outfit model. They develop a novel strategy for grouping Melanocytes tumors as generous or threatening by the examination of computerized dermoscopy pictures. The calculation pursues three steps: first, injuries are removed utilizing a self-producing neural system (SGNN); second, features descriptive of tumor shading, surface and fringe are extricated; and third, sore articles are grouped utilizing a classifier dependent on a neural system outfit model. To manage this troublesome presentation, new outskirt features are proposed, which can viably describe fringe anomalies on both complete sores and incomplete sores however fringe recognition for all database picture are unrealistic and the location result isn't appropriate. The outcomes show that arrangement accuracy is enormously upgraded by the utilization of the new fringe features and the proposed classifier model however results might be better for the therapeutic application. ***EuijoonAhn and Ashnil Kumar [6]*** proposed saliency-based sore division by means of foundation location in dermoscopic pictures. In this paper, creators have implemented a saliency-based division structure for the distinguishing proof and portrayal of skin injuries in dermoscopic pictures. The proposed system can be utilized as a saliency optimization calculation for injury

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division in dermoscopic pictures yet because of the absence of major pre-processing steps; the division results are not acceptable and need to improve. ***C. Benazzi et al. [7]*** proposed model angiogenesis in spontaneous tumors and implications for comparative tumor science. They proposed a comparative report on tumor examination utilizing the various techniques. From the study, they established that, the tumor characterization accuracy might be high if the preparation and grouping of the system will be proper. The preparation of an arrangement system is absolutely depending on the feature sets so need to an optimization calculation with the grouping system. ***B. Cheng et al. [8]*** proposed programmed telangiectasia examination in dermoscopy pictures utilizing adaptive pundit structure. They have picked BCC identification as opposed to vessel discovery as the endpoint. In spite of the fact that vessel recognition is characteristically simpler, BCC location has potential direct clinical applications. Little BCCs are perceivable ahead of schedule by dermoscopy and potentially noticeable by the mechanized strategies depicted in this examination. Experimental outcomes yielded an analytic accuracy as high as 84.6% utilizing the ADHDP approach, providing an 8.03% improvement over a standard multilayer perception technique.

Based on the survey we conclude some important point which helps to short out existing problem for automatic segmentation and classification of skin cancer from dermoscopic images. The tabular representation of literature survey is given in table I based on the advantages and disadvantages.

Table I: Literature survey based on advantages and disadvantages

Authors and Years	Proposed Work and Algorithm	Used Datasets in Work	Advantages of Proposed Work	Disadvantages of Proposed Work
PegahKharazmi [2017]	K-means clustering, Shape filters, and independent-component analysis (ICA)	ISIC Dataset	By using the K-mean clustering algorithm to segment the Vascular Structures of Skin Lesions give better segmentation results	Due the lack of feature optimization and classifier technique, the classification and segmentation result is not acceptable for medical science research point of view
Lequan Yu [2017]	Fully convolutional residual network (FCRN) for segmentation and deep convolutional neural networks (CNNs) for classification	ISBI 2016 Dataset	CNN is the better classier as compare to the other classifier because, CNN is multiclass classifier	The execution time of system is more due to FCRN based segmentation because its structure is more complex
Yading Yuan [2017]	Jaccard distance, pixel-wise classification for medical image segmentation and fully convolutionalneural networks (FCNN)	PH2 Skin Lesion Dataset	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	Due to pixel-wise classification for segmentation the time complexity of proposed segmentation is major drawback
N. C. F. Codella [2017]	U-Net based image segmentation and fully convolutional neural networks (FCNN)	ISBI 2016 Dataset	U-net based segmentation is better selection of segmentation technique and by using this efficiency of system is increase as compare to other technique.	The proposed work is only applicable for linear image during the classification process and need to improvement in the pre-processing steps for further usages of non linear images.
FengyingXie [2017]	Self-generating neural network (SGNN) based	Xanthous Race	The classification accuracy is greatly	The time complexity of system is more by suing

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	image segmentation and combination of back propagation neural networks with fuzzy logic for classification	Dataset and Caucasian Race Dataset	enhanced by the use of the new border features and the proposed classifier.	the SGNN for segmentation of lesion.

cancer from dermoscopic images using the different techniques and algorithms The comparative analysis of results based survey is given in table II and their further analysis is described by Fig 3.

Table II: Existing Work Comparison

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

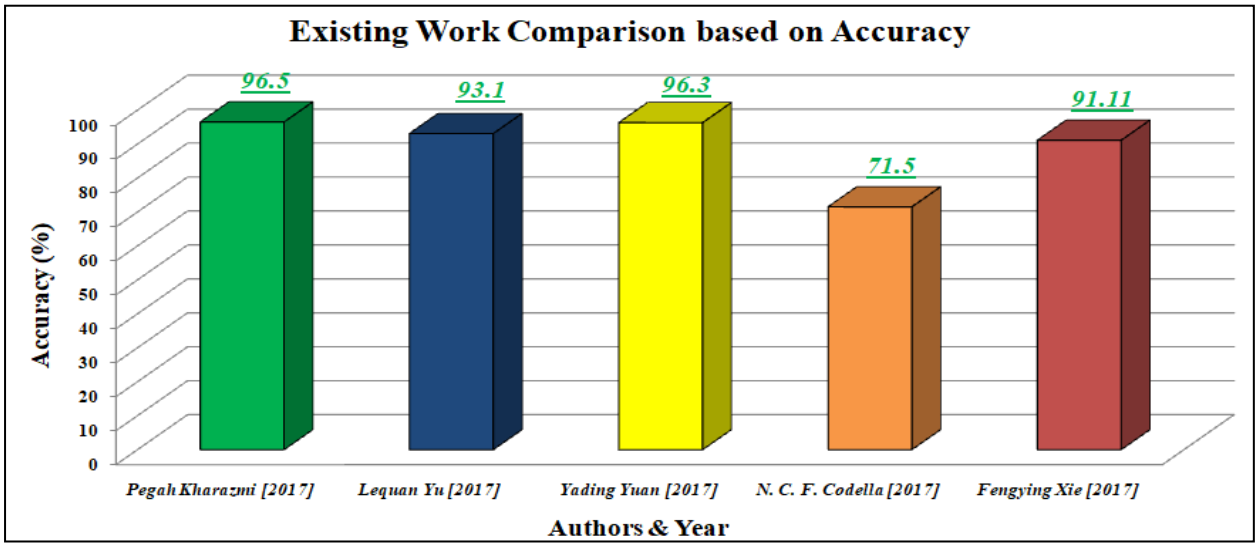

Fig.3: Comparison of accuracy

Fig.3 represents the comparative analysis of existing work based on the classification accuracy which is performed by different authors in different years. From the Fig 3, we observe that the accuracy achieve by *Pegah Kharazmi [1]* is better than other author by because of the concept ofK-means clustering with ICA feature extraction technique. There are many research territories in the robotized skin malignant growth determination framework that should be tended to. First in picture pre-processing noise expulsion in the unmistakable region that needs scientist's consideration. There are a few calculations for noise expulsion however their outcomes are not promising. As to, a great deal of research work is required to build up the segmentation calculations with unrivaled precision regarding the identification of the sore edges, just as to consider different issues in the advancement of computational arrangements, for example, computational execution and automaticity level. Selection of the ideal features for training is the beneficial of model of skin cancer classification. Numerous features are related with the skin injuries however how to choose the base quantities of features that give the best outcomes regarding exactness, multifaceted nature, computational time

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and execution is a difficult assignment. Some datasets are publically available. Here some existing dataset are given for melanoma detection from the skin images:

1) ***ISIC 2018:*** It contains the skin lesion analysis towards melanoma detection and the dataset is in the form of dermoscopic images. The dermoscopy is an imaging technique that eliminates the surface reflection of skin. It provides improved diagnostic accuracy.
2) ***PH-2 Dataset:*** It isa collection of dermoscopic image skin lesion data. The PH-2datasetcontainsa large amount of manual segmentation skin lesion for the clinical diagnosis and research purpose. The identification of several skin lesiondermoscopic structures is performed by specialist of skin diseases which are known as dermatologists. The PH-2 dataset of dermoscopic images will be made freely available for scientific research purposes.
3) ***ISBI 2017:*** It is a dermoscopic skin lesion images dataset which contains over 10,000 images for medical diagnosis as well as scientific research. A subset of the skin lesion dermoscopic images has undergone annotation and mark-up by recognized skin cancer experts.

3. CONCLUSION AND FUTURE WORK

This paper presents a comprehensive survey on automatic segmentation and classification of skin cancer from dermoscopic images. In this survey, we discusses in details the various existing approaches related to the skin cancer detection using the lesion images on human body. According to literature early detection of skin cancer can reduce the mortality rates and we review the state of the art in computer aided diagnosis system and examine recent practices in different steps of computer aided diagnosis systems using the different approaches. These systems employ various methods for preprocessing, segmentation, feature extraction and lesion classification by using the extracted features. Certain conclusions are drawn after the analysis of literature. Among machine learning or artificial intelligence techniques used for skin cancer diagnosis these days, it is the prominent and the diagnostic accuracy of these systems lies in between 70%-96% by utilizing the noise-removal, segmentation and real-time classification in skin cancer diagnosis system. From the survey we concluded that, the combination K-means clustering with the concept of shape filters using invariant feature extraction technique is better option in future.

REFERENCES

[1] Kharazmi, Pegah, et al. "Automated detection and segmentation of vascular structures of skin lesions seen in Dermoscopy, with an application to basal cell carcinoma classification." IEEE journal of biomedical and health informatics 21.6 (2017): 1675-1684.
[2] Yu, Lequan, et al. "Automated melanoma recognition in dermoscopy images via very deep residual networks." IEEE transactions on medical imaging 36.4 (2017): 994-1004.
[3] Yuan, Yading, Ming Chao, and Yeh-Chi Lo. "Automatic skin lesion segmentation using deep fully convolutional networks with jaccard distance." IEEE Trans. Med. Imaging 36.9 (2017): 1876-1886.
[4] Codella, Noel CF, et al. "Deep learning ensembles for melanoma recognition in dermoscopy images." IBM Journal of Research and Development 61.4 (2017): 5-1.
[5] Xie, Fengying, et al. "Melanoma classification on dermoscopy images using a neural network ensemble model." IEEE transactions on medical imaging 36.3 (2017): 849-858.
[6] Ahn, Euijoon, et al. "Saliency-based lesion segmentation via background detection in dermoscopic images." IEEE journal of biomedical and health informatics 21.6 (2017): 1685-1693.
[7] Benazzi, C., et al. "Angiogenesis in spontaneous tumors and implications for comparative tumor biology." The Scientific World Journal 2014 (2014).
[8] B. Cheng1, R. J. Stanley1, W. V. Stoecker2 and K. Hinton2, Automatic telangiectasia analysis in dermoscopy images using adaptive critic design
[9] J. W. Choi, B. R. Kim, H. S. Lee, and S. W. Youn, “Characteristics of subjective recognition and computer-aided image analysis of facial erythematous skin diseases: A cornerstone of automated diagnosis,” Brit. J. Dermatol., vol. 171, pp. 252–258, Aug. 2014.
[10] S. C. Hames et al., “Automated detection of actinic keratoses in clinical photographs,” PLoS One, vol. 10, p. e0112447, 2015.
[11] B. Cheng, R. J. Stanley, W. V. Stoecker, and K. Hinton, “Automatic telangiectasia analysis in dermoscopy images using adaptive critic design,” Skin Res. Technol., vol. 18, pp. 389–396, Nov. 2012.

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

[12] B. Cheng et al., "Analysis of clinical and dermoscopic features for basal cell carcinoma neural network classification," Skin Res. Technol., vol. 19, pp. e217–e22, Feb. 2013.
[13] P. Kharazmi, H. Lui,W. V. Stoecker, and T. Lee, Automatic detection and segmentation of vascular structures in dermoscopy images using a novel vesselness measure based on pixel redness and tubularness, Proc. SPIE, vol. 9414, Computer-Aided Diagnosis, 94143M, Mar. 2015.
[14] I. Zalaudek, J. Kreusch, J. Giacomel, G. Ferrara, C. Catricala, and G. Argenziano, "How to diagnose nonpigmented skin tumors: A review of vascular structures seen with dermoscopy: Part II. Nonmelanocytic skin tumors," J. Amer. Acad. Dermatol., vol. 63, pp. 377–386, Sep. 2010.