Comparative study of classification methods for diagnosis of Skin Cancer

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Abstract : With advent of technology, there is a side effect that affect human life and induces many diseases. People across globe are widely using the recent technology for the ease in the lifestyle. But this is inducing huge amount of pollution and unhealthy food and thereby use of medication (many a times self medication) results in allergies that may lead to skin cancer. If the skin cancer is treated in primary stages mortality rate across globe due to skin cancer can be reduced. This paper is an attempt to summarize the reported work and put forth a pathway to researchers to generate interest in area of medical imaging, recognizing the cancerous cells from the captured image and then using an expert system with a set of classifiers to predict whether the image has cancerous cells or not. Imaging, image segmentation and then application of classifier are the key steps in diagnosis of skin cancer cells.

***IndexTerms* – Skin cancer, Melanoma cells, Image segmentation, classifiers, image preprocessing.**

I. INTRODUCTION

As per the research [1,2], cancer can develop from almost any cell in the body, but it has been stated that skin cancers develop from non-pigmented cells[1] with two variations basal cell carcinoma and squamous cell carcinoma [1,2] (as shown in figure 1 and 2). Also malignant melanoma is rare but causes 75% of deaths. Over the decades, an exhaustive research has been done in detection of skin cancer. For skin cancer detection and classification, a variety of methods have been used with a scope of further research. Its very important to detect and classify the melanoma in early stages as later results in surgery, immunotherapy, chemotherapy, and/or radiation therapy [3].

As per the Cancer Statistics in India [4], approximate number of people having cancer is around 2.25 million. Every year, Over 11,57,294 lakh new cancer patients are registered and deaths due to cancer are 7,84,821. There is 9.42% and 9.81% risk respectively in female and male of developing cancer before the age of 75 years whereas risk of dying from cancer is 6.28% in females and 7.34% in males before the age of 75 years. Skin cancer is the most common cancer spotted in the US [5] as compared to India. Melanoma is the most dangerous type of skin cancer which has been one of the most important challenges of the public health in recent years [6].

According to the latest statistics, 91270 new cases of melanoma is predicted to be diagnosed in the United States in 2018 [8] whereas 7331 in India. But due to increase in pollution level, haphazard lifestyle chances have risen that Indian people also may expose more to skin cancer. It is the bright possibility of drastic rise in occurrence and the mortality result of this disease [10]. In US there is 53% increase in new melanoma cases per year since 2008[8, 11]. It has been found that if this type of cancer is diagnosed in its early phases, and an appropriate treatment [12, 13], survival rates are very promising [14].

Use of dermoscopy (as shown in figure 3), improves giving higher accuracy in melanoma diagnosis as compared to the naked eye inspection[15-17]. But there is a limitation that if an unskilled clinician is using such techniques then it will not generate promising results[18-21], so also for experts it is subjective as per their knowledge, experience and expertise which may produce different diagnostic results [18, 22, 23]. There is very much similarity in visual features between malignant skin tumors and benign skin lesions which cannot be easily differentiated by dermatologists. Also it has been reported that highly trained dermatologists and clinicians can detect melanoma generally less than 80% [24, 25]. Also the availability of highly trained dermatologists all over the world is very less. So it is necessary to give an approach of automatic skin lesion classification at the same level and accuracy as dermatologists or even higher is very crucial in public health.

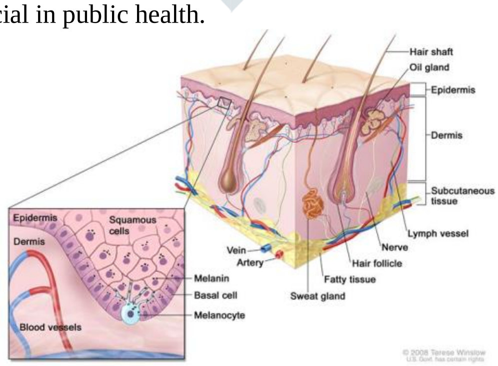

Figure 1 The epidermis and dermis layers in human skin with squamous cells, basal cells and melanocyte [7] (For the National Cancer Institute © (2008) Terese Winslow LLC, U.S. Govt. has certain rights).

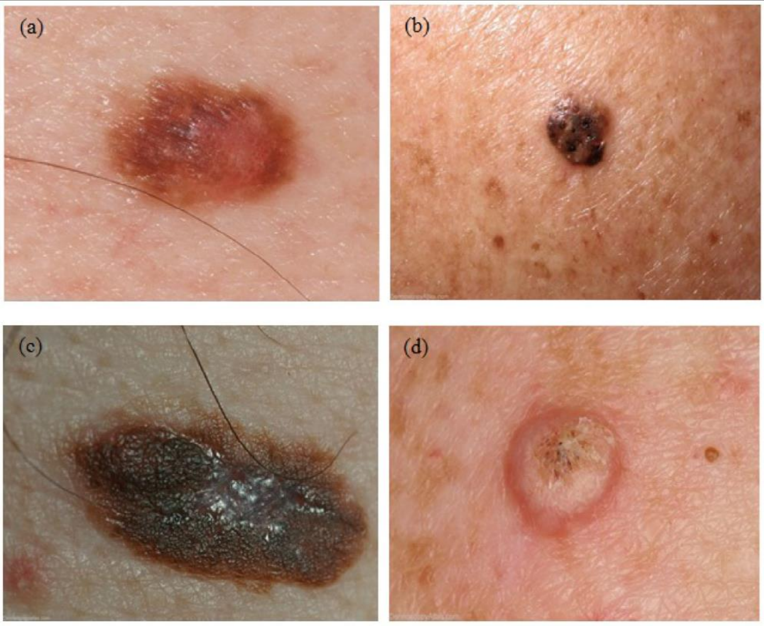

Figure 2 Four examples of skin lesions: (a) dysplastic nevus,(b) seborrheic keratosis, (c) melanoma, and (d) squamous cell carcinoma (images publicly available in [3]

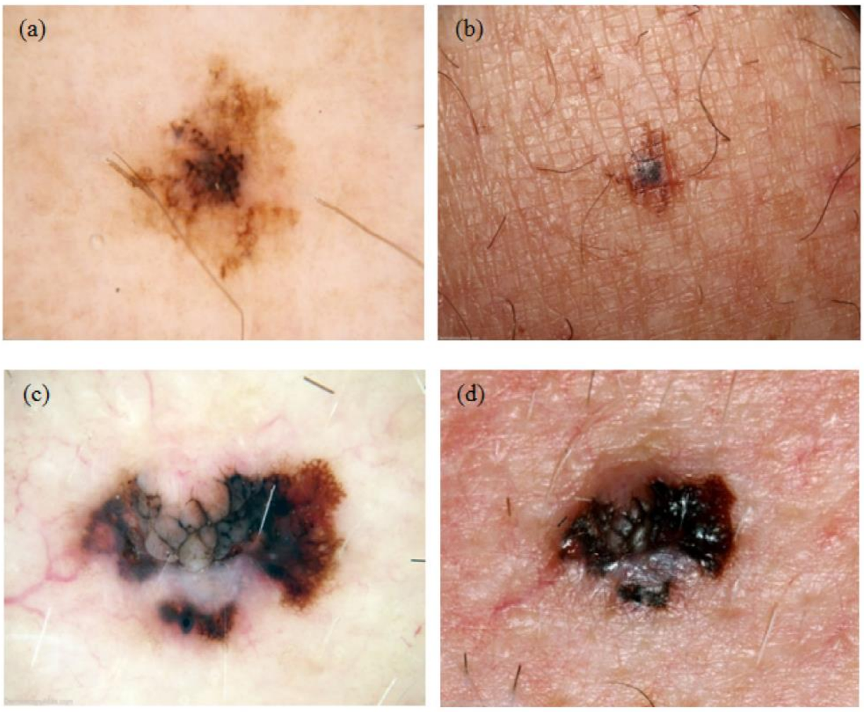

Figure 3 Examples of dermoscopy (a and c) and macroscopic (b and d) images: a and b are images of melanoma in situ, and c and d are of invasive melanoma (these images are publicly available in [3]).

Since past decades, a great amount of reported work in medical literature but yet there is scope of research in improving healthcare practices that are used in general clinical investigations. The scope of improvement lies under the fact that the new methods don't give that promising results. The factors for consideration are summarized by [26,27] that there is little instant relevance of clinical trials in the study; automated design structures were less clinically reliable. As per them some were lacking in clear purpose for the study detailing the insights into the data and optimizing model complexity with a proper sequence describing the integration of the automated system into clinical processes, and also stating the utility of a predictive model how it will improvise the clinical performance in diagnosis of skin cancer in limited data and training.

In this paper we have made an effort to study and compare various methods and techniques used for detection and classification of skin cancer. It explores the different feature extraction methods,

II. Study and Comparison of Various Methods

In previous years, generally researchers used a methodology in which the input was transformed into some important features. Then they used these features with some classifier and detected the pattern of cancer. Now a days, researchers are using deep learning techniques for detection and classification of cancerous cells. The key steps in recognition and classification of skin cancer cells are imaging techniques, image preprocessing and image segmentation.

Imaging techniques comprise of confocal scanning laser microscopy (CSLM), photography, optical coherence tomography (OCT), Dermoscopy, magnetic resonance imaging (MRI), ultrasound, and spectroscopic imaging [32–34]. Macroscopic images [29,35,36], and called dermoscopy or dermatoscopy images [28,30,31,37–40], are generally used in the digital analysis of skin lesions. In above Fig. 3 shows examples of dermoscopy and macroscopic images.

Image preprocessing comprise of some successful methods that have been used by authors [43,44] based on illumination correction. Some authors have reported to use artefact removal [41,47] while others have used colour space transformation [41–43], and contrast enhancement [41,42,45,46] for improving the accuracy of segmenting the pigmented skin lesions.

Author in [48] has used image segmentation method to separate tumor from the background with the key colors of Red, Green and Blue along with suitable coordinate transformation. In another reported work [49], an automatic method for segmentation of images of skin cancer and other pigmented lesions is explored. They have converted the color images into intensity images. By applying intensity thresholding and later with image edges the approximate image was extracted out. The authors then used double thresholding followed by fitting a closed elastic curve to initial boundary which was further adjusted to approximate the edges.

In the reported work [50], the authors have used a partial-differential equations (PDE) based system to identify the edge of skin lesion in digital clinical skin images on which they applied geodesic active contours or edge tracing approach. While exploring more we found, the author [51], used microarray technology for classification and diagnostic prediction of cancers. They have used probabilistic neural network (PNN) model for false positive and false negative multiclass cancer classification. Sigurdsson [52] designed in vitro Raman spectroscopy skin lesion classification using a nonlinear neural network classifier. Madasu [53], have used 'Fuzzy Co-Clustering Algorithm for Images (FCCI)' technique to segment medical images. They further extracted texture features for detecting blotches in skin lesions based on color information. Ganzeli [54] implemented SKAN: Skin Scanner – System for Skin Cancer Detection Using Adaptive Techniques – which separate melanoma images using image recognition. It used ABCDE visual rule and applied an ellipse-fitting algorithm for extracting and measuring the characteristics to make a decision for melanoma spot [54]. Authors in reported work [55], have devised an algorithm for the classification of melanoma based on k-means clustering, and Support Vector Machine (SVM). In the respective works [56], and [57], authors have used AdaBoost MC to classify skin lesions. The authors [58] and [59] have used a variety of features like lesion texture, visual, color, etc. and used neural networks for the developing a decision support system. In reported work [60], authors developed an algorithm for diagnosis of melanoma.

In [61], authors have used 21 Malignant and Benign Melanoma Features along with linear function as activation in ANN software Neural Lab. The linear function outputted 1 or 0 mapping the cancerous or non cancerous condition.

In a reported work [65], a Computer based early skin cancer detection system was proposed. They used Digital Image Processing Techniques for diagnosis and Artificial Neural Networks for the classification of Malignant Melanoma from other skin diseases. Dermoscopic images were collected and processed by various Image processing techniques. The cancerous region was separated from healthy skin by the method of segmentation. 2-D Wavelet Transform was used to extract unique features of the segmented images which were further classified as Cancerous and Non-cancerous.

After exploring more papers, it has been found that, authors[62-63] have reported that kNN classifier uses nearest neighbor rule and is fast, robust and effective on large noisy data. But at the same time it may be biased by the value of k, which increases computation complexity and may confuse by irrelevant attributes. In the reported work[64], an effective detection of skin cancer cells was proposed. Four features were chosen that were trained tested by using various classification techniques like SVM, KNN , Decision tree and Boosted tree have been done. The result procured by SVM was 93.70% was better than KNN, DT, BT.

III. Conclusion

After reviewing the reported work it has been noticed that image segmentation is necessary for computerized diagnosis of cancerous cells. Also it has been seen that skin lesion diagnosis is having huge scope of research in the area of its prevention and early diagnosis of skin cancer. Although the image segmentation of skin lesions has been addressed in several studies and successful applications, there is the potential to develop new methodologies and to improve the performance of existing methods.

The reviewed segmentation techniques were classified into: edge-, thresholding-, region-, AI- and active contourbased and other categories.. In conclusion, the future trends regarding the image segmentation of skin lesions are to search for superior accuracy in terms of the detection of the lesion edges, as well as to take into account other issues in the development of computational solutions, such as computational performance, automaticity level, image noise smoothing and removal, and image enhancement.

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