A Review on Skin Lesion Classification for the Diagnosis of Skin Cancer

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Abstract:
This study focuses on the different skin lesion classification techniques for the diagnosis of skin cancer and classification of skin lesion as melanoma or nevus. Nevus is a common mole, this can be completely overcome under the guidance of a dermatologist. Melanoma is considered as a common form of skin cancer and is the most dangerous form, it has a tendency to spread around the skin. Once it is diagnosed in its initial stage, there is a possibility to cure this cancer. Skin lesion classification by the use of image processing techniques help to detect the skin cancer early by segmentation, feature extraction and classification processes. This review presents different types of techniques used for skin lesion classification by use of various image processing techniques such as ABCD rules of dermatology is the most commonly used feature extraction techniques in the proposed review. Here reviewdiscuss a comparison of various classifiers such as k-NN, SVM, decision tree and ANN. Performance and effectiveness is validated only on the respective data set used by the respective research reports.

Keywords: Classifiers, feature extraction, Image processing, melanoma, Nevus, Segmentation.

I. INTRODUCTION

Skin cancer is a danger form of cancer. Patient with skin cancer is increasing day by day. There is different type of skin cancers; Basel cell carcinoma(BCC), Squamous carcinoma (SCC) and Melanoma. The first two cancer forms are non-melanoma. Melanoma is a serious type of skin cancer can develop anywhere on the body. They most often develop in the area that direct exposure to sun light. Melanocytes are skin cell found in the upper layer of the skin they produce a pigment known as melanin, which give skin its color. When skin is exposed to UV radiation from sun, it causes skin damage, that triggers melanocytes to produce more melanin. Melanoma occur when DNA damages from burning or tanning due to UV radiation trigger changes in the melanocytes, resulting uncontrolled cellular growth. Melanoma presents in different shapes, size and color. Melanoma is usually curable when detected and treated early. Once melanoma has spread deeper into the skin or other parts of the body, it become more difficult to treat. The estimated survival rate for US patients whose melanoma is detected early is about 98%. An estimated 7230 people (4740 men and 2490 women) would die of melanoma in US in the year of 2019. An estimated 192310 case of melanoma diagnosed in US in 2019, of those 95830 cases will be non-invasive and confined to the top layer of the skin. 69480 cases will be invasive, penetrating into the second layer of the skin. Hence early detection of melanoma is very important. Computer aided diagnosis (CAD) system help to detect melanoma cancer accurately with the aid of image processing techniques. We need to extract the ROI from background skin by segmentation procedure. Before going to segmentation stages, we need to remove the hair from the skin image, and also the noise in the image. There are different noise filters are used in different methodology, Gaussian filter is one of them [1], morphological bottom half filter[2] is another technique followed by closing operation as it removes the holes, fill them, from the image, standard Dull Razor algorithm[3] is used as pre processing stage to remove hair from the image. Thresholding is the first step in segmentation, edge detection follows after segmentation[4], mean shift algorithm is another segmentation scheme used by Lynn[3], one advantages of this approach is that we do not need to specify the number of clusters. There is a segmentation scheme based on combination of snake model and SVM [5]. For feature extraction mainly ABCD rules of Dermatology is used that stands for A- asymmetry B- border irregularity, C- color variations, D- diameter. Texture and color feature are also considered for feature extraction. Hybrid descriptors by combining different descriptor [6] is used to achieve better feature extraction results. Geometric feature is focused for detecting skin cancer by Linsangan[4], CAD system by textural analysis is another method [2]. Different classifiers are used to detect melanoma cancer accurately. Support vector machine(SVM) [1], k-NN [4], Artificial neural network (ANN) [7] and in a combination these methods are some of them. Care must be taken before choosing to classification algorithm, because it may sometimes result in inaccurate detection results. Different research had been done in different domain for an accurate detection of melanoma. The following literature review the various techniques for skin lesion classification. From the review we can see different image processing techniques for segmentation, feature extraction and classification.

II. LITERATURE REVIEW

This literature review discusses about various skin cancer detection methods followed by various researchers. In the work of Nay Chi Lynn and Zin Mar Kya [3], Image pre-processing is performed to remove unwanted hair and noise from the skin image. Hair removal process is removed by the use standard Dull Razor algorithm. Noise will be presented even after the hair removal takes place. These can be avoided by the use of filtering operation. Here in this study use the median filtering operation. Image segmentation is most important step in skin cancer classification, here utilize the mean shift algorithm to
separate the lesion from background, here there is no need to specify the number of clusters. After segmentation process feature extraction process is takes place to extract feature for further classification procedure. ABCD rules of dermatology is used in this work. There are mainly 3 types of classifier that is k-NN, SVM and decision tree is used in this system to classify the segmented lesion as melanoma or non-melanoma. Here SVM provides better classification accuracy of 78.2%. Work by Habeba Mahmoud, Mohamed Abdel-Nasser, and Osama A.Omer [2], based on detection of skin cancer by texture analysis methods, mainly four step- hair removal, filtering, feature extraction and classification. Hair removal is performed by morphological bottom hat filter followed by closing operation as it fills the gap. Median filter is used to remove the noise. There are four textural analysis methods such as Grey level co-occurrence matrix (GLCM), local binary pattern (LBP), HOG filters and local directional number (LDN) is used and their performance is analysed and evaluated. Multilayer perceptron is used as the classifier, this is formed by a neural network which consists of input layer, hidden layer and output layer. Here PH2 data set is used to test the system with a resolution of 768x 560 pixels, which consists of 80 common nevi, 80 dysplastic nevi and 40 melanoma, total 200 images. Best classification results were obtained when HOG filter is used as feature extractor. In the work by Mutlu Mete [8]in this method there is a two layered system, first layer three binary support vector machine (SVM) classifier and second layer is a novel decision maker functions based on the first layer. Here utilizes the ABCD rule for feature extraction techniques, achieves sensitivity of 73% and specificity of 100% that there is no false positive. The skin lesion classification system by Linsangan [4], focus on geometric features of skin lesion. Here the pre-processing steps include resizing, blurring, grey scaling, image dilation for enhancement of the acquired image and segmentation is performed by thresholding and edge detection procedure. Feature extraction by ABCD rule, area, perimeter, circularity index, greatest and shortest diameter, irregularity index, equitant diameter are the parameters loaded for classification purpose. k-NN is used as the classifier in this system with an accuracy of 90.0%the work by Mousa [9], skin lesion classification by using geometric feature analysis, thresholding and edge detection is used in segmentation process and ABD feature of lesion is extracted, k-NN classification algorithm is used for melanoma detection with 89% of accuracy. Y Liu [10], combining skin patterns and ABCD analysis for skin lesion classification. Skin line direction and skin line intensity of skin pattern is extracted and also asymmetry, border irregularity, colour (red, green, blue), variegation and diameter by ABCD rules of dermatology is extracted and combined by principal component analysis, which would increase the lesion classification accuracy. Harald Ganster [11], image obtained by Epiluminescence microscopy (ELM), segmentation was performed with a fusion strategy. ABCD feature selection method used with a non-parametric 24-NN classifier is utilized and achieved a good classification accuracy. 87% sensitivity and 92% of specificity for the detection skin cancer. Esteva [12], here train single CNN using 1,29,450 clinical images. Artificial neural network is capable of skin lesion classification similar to dermatologists.Rehman [13], this system consists of three steps segmentation, CNN feature extraction techniques, which consists of - extraction, ANN classifier. Grey level gaussian distribution is utilized for segmentation procedures. CNN feature extraction techniques are a good choice to achieves better classification, it avoids the over fitting problem and suitable for texture-based image analysis.Convolutional layer is the first layer that convolve different kernels of 7×7 pixel to give 16 different output channels, the output is fed into pooling layer to reduce the dimension and the top three fully connected layer, here use three layer connected model as the classifier. ISBI2016 data set is used to test the performance of the system, achieves an accuracy of 98.3%, classification accuracy is depending on the accurate segmentation. Inthe work by bunrungkun [5], propose image segmentation scheme based on support vector machine (SVM) and snake active contours.SVM is used to find appropriate parameter for snake algorithm. when an image is input into the system, SVM choosing templates from A…. N templates, similar to the input image. Here is pre-processing stage before classification.

III. CONCLUSION

Skin lesion classification based on CAD basically consists of image pre-processing, segmentation, feature extraction and classification. Image pre-processing stages mainly consists of noise removal and hair removal. Noise removal is very important because inclusion of noise in the images get affect the segmentation results and variability in classification results. Hence hair removal is a significant step before applying to segmentation and feature extraction stages. ROI from skin lesion extracted by basic segmentation processes. In most of the cases uses ABCD rules of dermatology and texture features and colour features for feature extraction. Extracted feature is fed into classifier andthen classifies the lesion as melanoma or non-melanoma. Care must be taken before applying to classification algorithm because false classification may get affect the entire system. Mainly k-NN, Support vector machine (SVM), decision tree and ANN is used as the classifiers by most of the techniques, ANN and SVM provides better classification accuracy.

IV. REFERENCES


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