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Comparative Analyses of Classifiers for Diagnosis of Skin Cancer using Dermoscopic Images

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Abstract

In recent years one of the emerging deadliest diseases is Skin cancer. Skin cancers are of different types. But melanoma, basal cell carcinoma and squamous cell carcinoma these types are most commonly found in humans. The death rate due to skin lesions can be reduced if detected early. An efficient image analysis module has been developed with efficient algorithm to detect the skin lesions. In the analysis system classification plays an important role in identification of defect. In the proposed system different types of classifiers such as Support Vector Machine, ensemble classifier, probabilistic neural network and adaptive neuro-fuzzy inference system classifiers are used in the classification process and their performance is compared and the classifier with best performance is used in identifying the skin lesions.

Keywords: Classification, Ensemble, Image Segmentation, Neural Network, Neuro-Fuzzy, Skin Cancer

1. Introduction

Now a days the death rate in human increases due to skin cancer. The cell development deviates from to abnormal resulting in skin cancer. This paper mainly focuses on three types of cancers namely Basal Cell Carcinoma (BCC), (SCC) and melanoma. Exposure of skin to sunlight at higher rate results in Basal Cell Carcinoma. Raised red bump will be the physical structure of BCC whereas SCC appears as red bump. BCC and SCC are called as non-melanoma since it is not of destructive type. But melanoma is the deadliest form of skin cancer. The death rate in human due to melanoma is increasing at an alarming rate. Melanoma spreads through metasis. The color of melanoma changes and it has irregular borders. Possibility of reducing the death rate due to skin cancer is high by early detection. To detect the pigmented skin lesions a major tool is used. It's known as dermoscopy. Dermoscopy refers to the examination of skin using skin surface microscopy. With the help of dermoscopy the pigmented lesion is examined in terms of color and structure.

In this paper a dataset containing different skin lesion types are initiated for preprocessing in which the noises are removed and then the enhancing of image takes place. The enhanced image is segmented and their features are extracted. Finally the classifier classifies the skin lesion types based on the extracted features of skin lesion types.

2. Related Work

Doukas et al. developed a system to detect the moles in skin images using mobile application and classify them as melanoma, nevus and benign lesions based on their brutality. The experimental result shows that the Support Vector Machine (SVM) has accuracy of 77.06%[5].

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Abbas proposed an effective and simple method to detect the borders of tumors in color images. In order to differentiate the tumor from the background the system makes use of an adaptive color metric from RGB plane. Using this suitable coordinate transformation, the image is segmented and the tumor portion is then extracted from the segmented image and borders are drawn[8].

Xie et al. developed a system that uses morphological closing top-hat operator for enhancing hair. In the resulted image statistical thresholding is applied to detect the hair regions. Then Partial Differential Equation (PDE) based in painting method is used for excluding hair regions. This method is used only for dark hairs[9].

Massone et al. developed mobile teledermoscopy. This system was designed to monitor the patients with growing skin disease. This system enables the dermoscopic image transmission through e-mail or particular web application. But this system has a drawback, it lacks automatic image processing module and completely depends on the dermatologist to diagnose and classify the dermoscopic images. Hence, this teledermoscopy is not considered a real-time system[10].

Mahmoud proposed an automatic skin cancer classification system. The proposed system includes preprocessing to enhance the image. Two segmentation methods used to segment the skin lesion. The features used for classification is the coefficients created by Wavelet decompositions and simple wrapper curvelet[15].

3. Methodology

The methodology used in the detection of skin cancer is shown in Figure 1. Initially dermoscopic image is converted into grayscale image and it's preprocessed for the removal noise such as bubbles and hairs. The preprocessing is an essential step which helps in accurate diagnosis of skin lesion types. In preprocessing initially the hair in the dermoscopic image is removed by using morphological closing operation and after the exclusion of hair the missing hair pixel is replaced by using bicubic interpolation. After the removal of noise the image is enhanced using morphological opening and closing operation. Then enhanced image is segmented using Otsu's segmentation method which is completely unsupervised. The segmentation process is carried on to segment the cancer image from the normal skin. The features of segmented image such as mean, standard deviation, Euler number, eccentricity is extracted and they are finally given as an input to the classifiers for the accurate detection of skin lesion types.

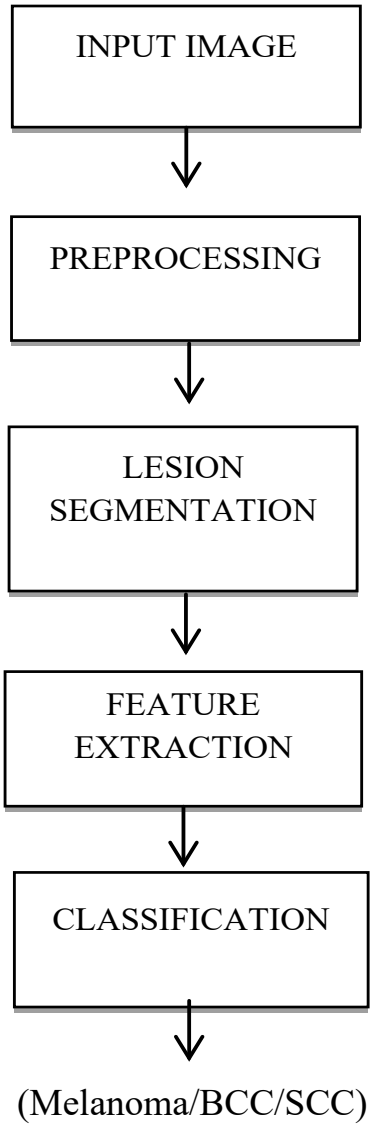

Figure 2. Flow chart of proposed image analysis system.

3.1 Classification

Classification is an important stage in identifying skin cancer types. In classification classifier is used for object recognition and classification. The classifiers recognize the object and classify based on the extracted features of an image given as an input. There are two important phases in the classification. They are training and testing phase. In training phase, the pre-determined data and its associated class labels are used for classification.

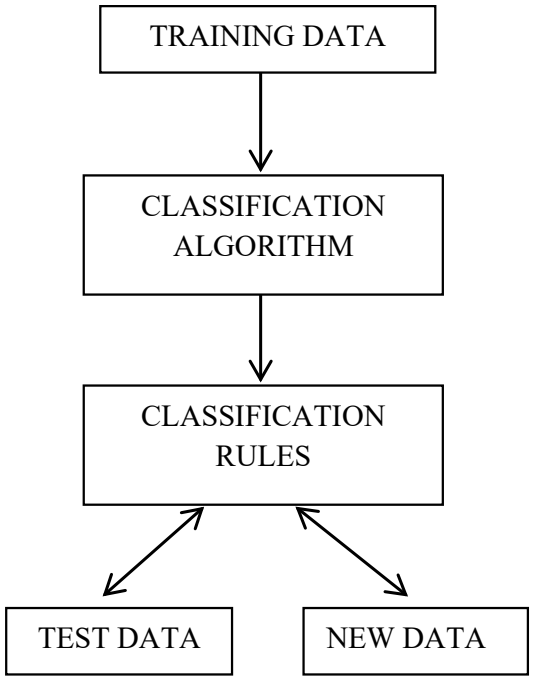

Figure 2. Different phases in classifier.

The different phases in classifier are shown in Figure 2. The different phases are training and testing. In this paper different types of classifiers are used in the diagnosis of dermoscopic images and their performance is finally compared.

3.1.1 Using SVM Classifier

Support Vector Machine is the supervised method of classifier. SVM classifier includes two types of classification methods - they are linear and nonlinear. The nonlinear SVM classifier classifies more accurately than linear SVM classifier by using kernel trick. In this paper RBF kernel is used in nonlinear classifier for accurate classification of different types of skin cancer. The concept of SVM is based on decision plane. The decision plane can also be known as hyper plane. Set of objects with different class membership is separated by hyper plane. That is the points on one side of the hyper plane are classified as 'yes', while the others are classified as 'no'.

3.1.2 Using Ensemble Classifier

Ensemble classifier is a supervised classifier because these classifiers can be trained and then used to make prediction. Ensemble provides good result in case of significant diversity among the models. In ensemble different types of algorithms are present. In the proposed system boosting algorithm AdaBoost is used. It is an efficient algorithm in diagnosing the defects.

3.1.3 Using Probabilistic Neural Network

Probabilistic neural network consist of four layers. It is a feed forward neural network. The architecture of PNN is shown in Figure 3.

The probabilistic neural network has four layers. Unlike SVM classifier N number of classes can be used in PNN. The first is the input layer. The features are given

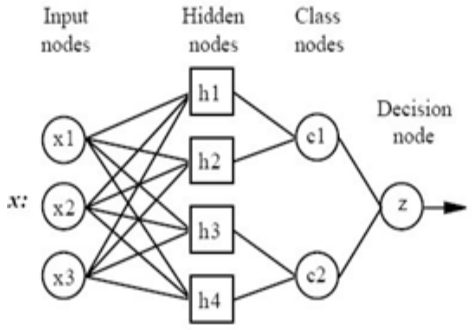

Figure 3. PNN architecture.

as an input; these features are branched into each node in the middle layer. The middle layer is the hidden node. The hidden nodes are collected in groups. There is Gaussian function is calculated for each feature vector in hidden layer. All of the Gaussian functions are mapped are mapped to the output layer. The final layer is the decision layer.

3.1.4 Using Adaptive Neuro-Fuzzy Inference System

ANFIS is a hybrid classifier consists of two parts. The first is the antecedent part and second is the conclusion part. The antecedent part and the conclusion part are connected together by rules. Figure 4 shows the ANFIS architecture. There are five layers in ANFIS architecture. The important part in ANFIS architecture is fuzzification and defuzzification. The first layer performs fuzzification operation and the second layer performs fuzzy AND operation. The fuzzy rule is executed in fourth layer and last layer computes the output of fuzzy by summing up the fourth layer output.

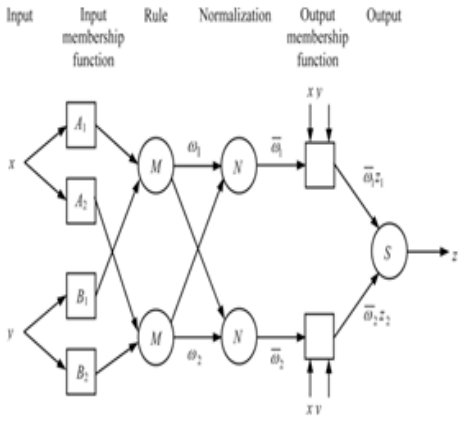

Figure 4. ANFIS architecture.

4. Experimental Results

In the proposed system different types of classifiers such as Support Vector Machine, ensemble classifier, ensemble classifier, probabilistic neural network and adaptive neuro-fuzzy inference system are tested on a dataset containing 200 images that includes three types of skin lesions such as melanoma, BCC, SCC. Sensitivity, specificity and accuracy are the parameters used to identify the performance of classifiers. These parameters can be evaluated using the formula given below,

Sensitivity = TP/ (TP+FN) (1)
Specificity = TN/ (TN+FP) (2)
Accuracy = (TP+TN)/(TP+TN+FP+FN) (3)

The parameter evaluation for three types of classifier is shown in above Table 1.

Table 1. Parameters evaluated for classifiers

Classifiers	Sensitivity (%)	Specificity (%)	Accuracy (%)
ENSEMBLE CLASSIFIER	70	40	55
SVM	72	80	76
PNN	80	80	80
ANFIS	91	85	88

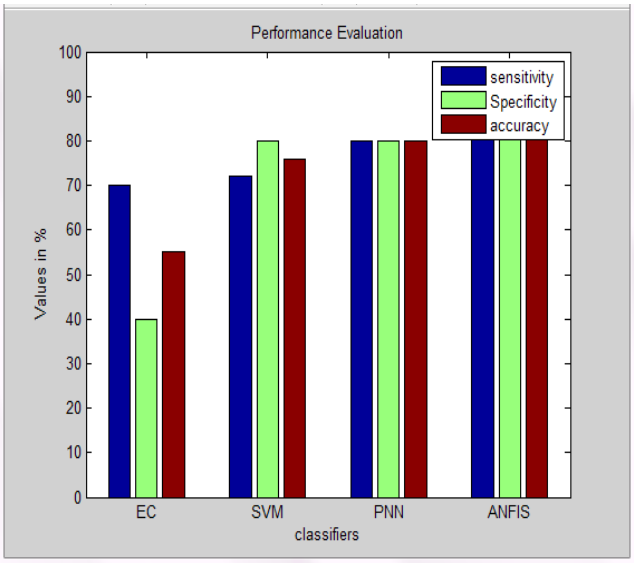

Figure 5. Performance comparison of three classifiers.

The above Figure 5 clearly shows the comparison of classifiers based on their performance.

5. Conclusion and Future Work

An efficient image analysis system has been developed to diagnosis the skin lesion types and different types of classifiers are applied to the dataset containing 200 images containing all three types of skin lesions. Classifiers performance was compared based on the parameters evaluated for each classifier. The experimental result clearly shows that the hybrid classifier better in identifying the skin lesion when compared to SVM, ensemble classifier and PNN. In future work the skin lesion diagnosis can be performed in colored image.

6. References

1. Abuzaghleh O, Barkana BD. Noninvasive real-time automated skin lesion analysis system for melanoma early detection and prevention. IEEE Journal of Translational Engineering and Health Medicine. 2015; 3.
2. Bhardwaj A, Bhatia JS. An image segmentation method for early detection and analysis of melanoma. IOSR Journal of Dental and Medical Sciences. 2014; 13(10):18–22.
3. Xing G, Ken C, Xiaoguang H. Artificial Neural Network based detection of skin cancer. IEEE Conference on Image Processing. 2012; 3.
4. Ballerini L, Li X, Fisher RB. Content-based image retrieval of skin lesions by evolutionary feature synthesis. Int Conf IEEE Eng Med Biol Soc. (EMBC). 2013; 4.
5. Doukas C, Stagkopoulos P, Kiranoudis CT, Maglogiannis I. Automated skin lesion assessment using mobile technologies and cloud platforms. Proc Annu Int Conf IEEE Eng Med Biol Soc. (EMBC); 2012 Aug-Sep. p. 2444–7.
6. Abbas Q, Fondon I, Rashid M. Unsupervised skin lesions border detection via two-dimensional image analysis. Methods Programs Biomed. 2011; 104(3):e1–15.
7. Suer S, Kockara S, Mete M. An improved border detection in dermoscopy images for density based clustering. BMC Bioinformatics. 2011; 12(S10).
8. Abbas Q, Garcia IF, Emre Celebi M, Ahmad WA. Feature-preserving hair removal algorithm for dermoscopy images: Skin Res Technol 2011; 0:1– 10.E pub 2012/01/04. Ercal F. Detection of skin tumor boundaries in color images. IEEE Transactions on Medical Imaging. 1993 Sep; 12(3):624–6.

9. Xie FY, Qin SY, Jiang ZG, Meng RS. PDE based unsupervised repair of hair-occluded information in dermoscopy images of melanoma. Comput Med Imaging Graph. 2009; 33:275–82. Epub 2009/03/06.
10. Massone C, Brunasso AM, Campbell TM, Soyer HP. Mobile teledermoscopy_melanoma diagnosis by one click? Seminars Cutaneous Med Surgery. 2009; 28(3):203–5.
11. Ramlakhan K, Shang Y. A mobile automated skin lesion classification system. Proc 23rd IEEE Int Conf Tools Artif Intell. (ICTAI); 2011 Nov. p. 138–41.
12. Whiteman D, Green A. Melanoma and sunburn. Cancer Causes Control. 1994; 5(6):564–72.
13. Poulson M, et al. High-risk Merkel cell carcinoma of the skin treated with synchronous carboplatin/etoposide and radiation: A Trans-Tasman Radiation Oncology Group study_TROG 96:07. J Clin Oncol. 2003; 21(23):4371–6.
14. Fleming MG, Steger C, Zhang J, Gao J, Cognetta AB, Pollak I, Dyer CR. Techniques for a structural analysis of dermatoscopic imagery. Computerized medical imaging and graphics the official journal of the Computerized Medical Imaging Society. 1998; 22(5):375–89.
15. Mahmud R, Ramli A, Al-Qdaha M. A system of microcalcifications detection and evaluation of the radiologist: Comparative study of the three main races in Malaysia. Elsevier Journal of Computers in Biology and Medicine. 2005; 35(10):905–14.