International Journal of Future Innovative Science and Engineering Research (IJFISER)
Volume - 2, Issue - II ISSN (Online): 2454- 1966

Research Manuscript Title

COMPARITIVE ANALYSIS OF MACHINE LEARNING BASED CLASSIFIER FOR DETECTION OF SKIN CANCER USING DERMOSCOPIC IMAGES

Kavimathi.P[1], Sivagnanasubramanian.S.P[2]

[2]Assistant Professor, Sri Venkateswara College Of Engineering, Sriperumbudur.

E-Mail: ***Kavi.jit92@gmail.com***

JUNE – 2016

www.istpublications.com

COMPARITIVE ANALYSIS OF MACHINE LEARNING BASED CLASSIFIER FOR DETECTION OF SKIN CANCER USING DERMOSCOPIC IMAGES

Kavimathi.P[1], Sivagnanasubramanian.S.P[2]

[2]Assistant Professor, Sri Venkateswara College Of Engineering, Sriperumbudur.

E-Mail: *Kavi.jit92@gmail.com*

ABSTRACT

Skin cancers are the most common form of cancers in humans. Skin cancer may be Melanoma, Basal and Squamous cell carcinoma among which Melanoma is the most precarious. It is compulsory to recognize it in its early stage for its proper cure. To detect the skin cancer in its early stage an image analysis system has been developed with efficient algorithms. The image analysis module contains preprocessing, lesion segmentation, feature extraction, and classification. The dermoscopy image of skin cancer is taken and it is subjected to various pre-processing techniques for removal of noise and image enhancement. Then the image is undergone image segmentation using thresholding. Each image has unique features. Such features are extracted and given as an input to classifier. The classifier classifies the given image as Basal cell carcinoma (BCC) or squamous cell carcinoma (SCC) or melanoma. The classification system is based on the application of Support Vector Machine (SVM) and Probabilistic Neural Network (PNN).The accuracy of proposed system is calculated using different classification techniques.

Keywords— **Image segmentation, neural network, Skin cancer**

1. INTRODUCTION

Skin cancers are cancers that arise from the skin. The skin cancers occur due to the development of abnormal cells that have the ability to spread to other parts of the body. There are three main types of skin cancers such as basal-cell carcinoma, squamous-cell carcinoma and melanoma. Basal-cell cancer grows slowly and can damage the tissue around it. But they do not have the ability to spread to distant area. Squamous-cell cancer is more likely to spread. The basal cell carcinoma and squamous cell carcinoma are categorized as non-melanoma because they are not of destructive type. Melanomas are the most aggressive. It can originate in any part of the body that has melanocytes. Melanoma spreads through metasis and they are proved to be very fatal. Melanoma has more than one color and irregular edges. Greater than 90% of cases are caused by exposure to ultraviolet radiation from the sun. The light skin people are easily affected by skin cancer. The most common type is non-melanoma skin cancer, which occur in 2-3 million people per year. Basal-cell and squamous-cell cancers rarely results in death. Globally melanoma occurred in 232,000 people and resulted in 55,000 deaths. AS compared to all types of skin cancer melanoma is quite common. Early detection of skin cancer reduces the mortality and morbidity of patients.

2. RELATED WORK

Doukas et al. developed a system consisting of a mobile application to detect the moles in skin images and categorize them according to their brutality into melanoma, nevus, and benign lesions. As indicated by the experimental results, Support Vector Machine (SVM) has accuracy of 77.06%. [5]

Abbas proposed an effective and simple method to detect the borders of tumors in color images. Inorder 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 to enhance hair and applied a Statistical threshold to the resulted image to detect the hair regions. Then partial differential equation (PDE) based inpainting method is used to remove hairs. This study focuses mainly on dark hair. [9]

Massone et al. introduced mobile teledermoscopy: The system was designed in such a way to manage the patients with growing skin disease. Teledermoscopy enabled transmission of dermoscopic images through e-mail or particular web-application. This system lacked an automated image processing module and was totally depended on the dermatologist to diagnose and classify the dermoscopic images. Hence, it is not considered a real-time system. [10]

Ramlakhan and Shang introduced a mobile automated skin lesion classification system. The system incorporated three major components: image segmentation, feature calculation, and classification. Experimental result showed that the system was inefficient, achieving an average accuracy of 66.7%, with average sensitivity of 60.7% and specificity of 80.5%.[11]

3. METHODOLOGY

The methodology used in the diagnosis of skin cancer is given below,

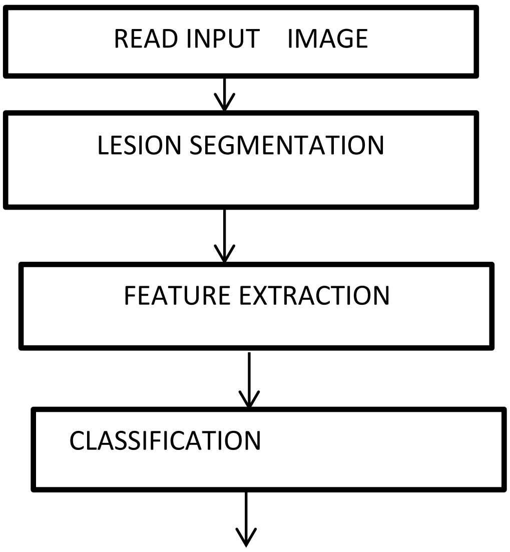
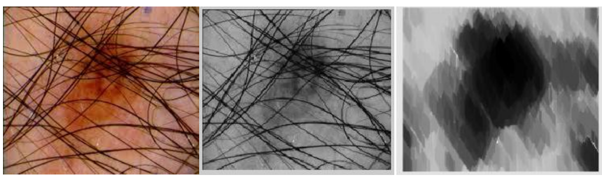


Fig.1 Flowchart for the proposed image analysis system.

Fig.1 shows the flowchart of proposed image analysis system consisting of preprocessing, lesion segmentation, feature extraction and classification.

A.PREPROCESSING:

The dermoscopy images consist of noise in the form of hair, bubbles etc. The presence of noise in dermoscopy images results in misclassification. To avoid this, images are subjected to various image processing techniques such as hair exclusion, contrast enhancement and image smoothening. Initially the exclusion of hair from dermoscopy image is performed using morphological closing operation with bicubic interpolation. Morphological closing operation is used to exclude the hair from lesion and bicubic interpolation is applied to fill in the hair position gaps. Bicubic interpolation fills the gaps by using the whole image information without any neighboring spatial dependency. After excluding the hair contrast of an image is enhanced by using histogram equalization and morphological filtering operation. After enhancing the wiener filter is used to smoothen the image.



(a) (b) (c)

Fig.2 Illustration for hair exclusion, (a) Original image,

(B)Gray scale image, (c)Hair excluded image.

B.LESION SEGMENTATION:

Lesion segmentation is the process of segmenting the pigmented skin lesion from the background. The segmentation method used in proposed system is Otsu's segmentation. Otsu's method is finest method for thresholding the objects(lesions)from background skin. The input to Otsu's segmentation method is gray level image. Otsu's segmentation divides the input image into two classes C0={0,1,2,…t} and C1={t+1,t+3,…..,L-1.The probability of occurrence of gray level i is given as

$$Pi= \frac{ni}{n} \qquad (1)$$

Where Pi is the probability of occurrence of grays level i, ni is the number of pixels in gray level i and n is the total number of pixels in an input image. The probability of the classes C0 and C1 is given as

$$W0=\sum_{t=0}^{t} pi \qquad (2)$$

$$W1=\sum_{i=t+1}^{L-1} pi \qquad (3)$$

The mean of two classes can be computed by

$$\mu0(t) = \sum_{i=0}^{t} \frac{iPi}{W0(t).\mu1(t)} \qquad (4)$$

$$\mu1(t) = \sum_{i=t+1}^{L-1} \frac{iPi}{W1(t)} \qquad (5)$$

After applying the threshold, the edges of the output image become irregular. To smoothen the edges, morphological opening and closing operation is used.

Fig.3 Segmented image

Fig.3 shows the segmented image after applying Otsu's segmentation and morphological operation.

C.FEATURE EXTRACTION:

Feature extraction is the important step because based on the extracted features the images will be classified. The extracted features should be detailed enough to be classified. By extracting features, the image data is narrow down to a set of features which can distinguish between three types of skin cancer. The extracted features are mean, standard deviation and shape features. The mean and standard deviation describes the skin pigmentation between the lesion and surrounding skin. The pigment transition describes the transition between the injury and the setting points of skin on each side that is the level of steepness. To portray the lesion shape best- fit ellipse is used. It's also used in calculating the degree of irregularity. The lesion shape feature is calculated by the variation between best-fit ellipse and lesion shape.

$$L(S)= \frac{\sum D(P)}{LB} \qquad (6)$$

Where p is the any pixel on lesion boundary and LB represents the total number of pixels on the lesion boundary.

D.CLASSIFICATION:

Lesion classification is the final step. In order to classify an image two classification methods SVM and Probabilistic Neural Network are described as follows:

A.USING SUPPORT VECTOR MACHINE:

Support Vector Machines are based on the concept of decision planes. Decision plane is also known as hyper plane that separates between a set of objects having different class memberships. The separating line defines a boundary on the right side of which all objects are GREEN and to the left of which all objects are RED. That is all points on one side of the hyper plane are classified as 'yes', while the others are classified as 'no'.

The algorithm of SVM classifier is given as

1 .Definition of Classification Classes - Depending on the objective and the characteristics of the image data, the classification classes should be clearly defined.

2. Selection of Features - Features to discriminate between the classes should be established using multi-spectral and/or multi-temporal characteristics, textures etc.

3. Sampling of Training Data - Training data should be sampled in order to determine appropriate decision rules.

4. Estimation of Universal Statistics - Various classification techniques will be compared with the training data, so that an appropriate decision rule is selected for subsequent classification.

5. Classification - Based on the decision rule, all pixels are classified in a single class. There are two methods of pixel by pixel classification and per-field classification, with respect to segmented areas.

B. USING PROBABILISTIC NEURAL NETWORK:

A probabilistic neural network (PNN) is a feed forward network, which was derived from Bayesian network and a statistical algorithm called Kernel Fisher discriminant analysis.

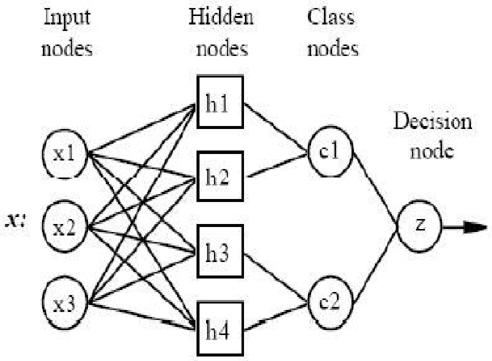


Fig. 4 Architecture of PNN

Fig.4 shows the architecture of PNN classifier. The Probabilistic neural network has four layers:

- Input layer
- Hidden layer
- Pattern layer / Summation layer
- Decision layer

The input layer contains N nodes, one for each of the N input features of a feature vector. These nodes are fan-out nodes that branch at each feature input node to all nodes in the hidden layer.

The hidden nodes are collected in groups. It consist s of the Gaussian functions formed using set of given data points as centers. This layer performs an average operation of the outputs from the second layer for each class. The decision layer predicts the target category by comparing the weighted votes for each target category accumulated in the pattern layer and uses the largest vote to predict the target category.

The algorithm of PNN classifier is given as

Step 1. Read input vector and feed it to each Gaussian function in each class.

Step 2. For each group of hidden nodes, Gaussian functional values are computed at the hidden nodes.

Step 3. For each group of hidden nodes, computed Gaussian functional values are feed to the single output node for that group.

Step 4. At each class output node, sum all of the inputs and multiply by constant.

Step 5. Maximum value of all summed functional values is found at the output nodes.

4. EXPERIMENTAL RESULTS

In this section experiments are conducted to verify the performance of the proposed system. The dataset contains 200 dermoscopic images of lesions including Melanoma, BCC and SCC. They were undergone preprocessing and segmentation. After segmentation the features were extracted and are given as input to different classification methods i.e. Support vector machine and probabilistic neural network. The parameters such as sensitivity, specificity and accuracy were calculated to measure the performance of two classifier. The above parameter can be calculated as:

$$Sensitivity = TP/\ (TP+FN) \quad (7)$$

$$Specificity = TN/\ (TN+FP) \quad (8)$$

$$Accuracy = (TP+TN)/\ (TP+TN+FP+FN) \quad (9)$$

Classifier	Sensitivity (%)	Specificity (%)	Accuracy (%)
SVM	72	80	76
PNN	80	80	80

Table 1.Evaluated parameters

Table 1.shows the evaluated parameters of SVM and PNN classifiers. From Table 1. it is clear that PNN achieves better sensitivity, specificity and accuracy than SVM classifier.

5. CONCLUSION

An image analysis system has been designed with efficient algorithms to detect the dermoscopy images. This paper presents various methods for classification of skin cancer. The proposed system is evaluated on 200 images for classification of skin cancer using SVM and Probabilistic Neural Network. Among these two classification methods we conclude that the classification using Probabilistic Neural Network is better compared to Support Vector Machine.

REFERENCES

[1] Omarabuzaghleh,Buketd.barkana,“Noninvasive Real-Time Automated Skin Lesion Analysis System for Melanoma Early Detection and Prevention”, IEEE journal of translational engineering and health medicine,Vol. 2, 2015.

[2] Arushi Bhardwaj, Dr. J.S Bhatia2, “ An Image Segmentation Method for Early Detection and Analysis of melanoma*”,* IOSR Journal of Dental and medical sciences, Vol. 3, 2014.

[3] Geng Xing, Chen ken, Hu Xiaoguang “Artificial Neural Network Based Detection of Skin Cancer”, IEEE Conference on image processing, Vol. 3,2012

[4] Lucia Ballerini, Xiang Li, Robert B. Fisher, “Content-Based Image Retrieval of Skin Lesions by Evolutionary Feature Synthesis”, Int. Conf. IEEE Eng. Med. Biol. Soc. (EMBC),, Vol.4, 2013.

[5] C. Doukas, P. Stagkopoulos, C. T. Kiranoudis, and I. Maglogiannis,``Automated skin lesion assessment using mobile technologies and cloud platforms," in Proc. Annu. Int. Conf. IEEE Eng. Med. Biol. Soc. (EMBC),Aug./Sep. 2012, pp. 2444_2447.

[6] Q. Abbas, I.Fondon and M. Rashid, “Unsupervised skin lesions border detection via two-dimensional image analysis”, Methods Programs Biomed,vol.3 Int.Vol.4, 2011.

[7] S.Suer, S.Kockara, and M. Mete, “An improved border detection in dermoscopy images for density based clustering," BMC Bioinformatics., vol.12, 2011.

[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.Epub 2012/01/04.F. Ercal, “Detection of Skin Tumor Boundaries in Color Images”, IEEE Transactions on Medical Imaging, vol. 12, no. 3, September 1993, pp: 624 – 626.

[9] Xie FY, Qin SY, Jiang ZG, Meng RS. PDE based unsupervised repair of hair-occluded information in dermoscopy images of melanoma. ComputMed Imaging Graph 2009; 33: 275–282. Epub 2009/03/06.

[10] C. Massone, A. M. Brunasso, T. M. Campbell, and H. P. Soyer, “Mobile teledermoscopy_Melanoma diagnosis by one click", Seminars Cutaneous Med. Surgery, vol. 28, no. 3, pp. 203_205, 2009.

[11] K. Ramlakhan and Y. Shang, “A mobile automated skin lesion classification system," in Proc. 23rd IEEE Int. Conf. Tools Artif. Intell. (ICTAI), Nov. 2011, pp. 138_141.

[12] D. Whiteman and A. Green, ``Melanoma and sunburn," Cancer Causes Control, vol. 5, no. 6, pp. 564_572, 1994.

[13] M. Poulsen 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., vol. 21,no. 23, pp. 4371_4376, 2003.

[14] M.G. Fleming, C. Steger, J. Zhang, J. Gao, A. B. Cognetta, I.Pollak, C.R. Dyer,“Techniques for a structural analysis of dermatoscopic imagery”, Computerized medical imaging and graphics the official journal of the Computerized Medical Imaging Society (1998), Volume: 22, Issue: 5, Pages: 375-389.

[15] Alina Sultana, Mihai Ciuc, Tiberiu Radulescu,Liu Wanyu, Diana Petrache, Preliminary work on dermatoscopic lesion segmentation, EUSIPCO,2012.