Melanoma Classification Using Probabilistic Neural Network

GREESHMA M R
PG student
Electronics and Communication Department
Mohandas College of Engineering and Technology,
MCET, Kerala, India
greeshmamurali90@gmail.com

ASHA T S
Assistant professor
Electronics and Communication Department
Mohandas College of Engineering and Technology
MCET, Kerala, India
ashakts@gmail.com

Abstract: ***Skin cancer is the uncontrolled growth of abnormal skin cells, it developed on the epidermis. Melanoma is a deadliest type of skin cancer that begins in the melanocytes. Melanoma cases are increasing faster than any other cancer. This cancerous growth develops when an unrepaired DNA damages the skin cell which causes the cell to multiply rapidly and form a malignant tumor.Early detection of melanoma is almost curable, if not removed early, while thin, melanoma often grows rapidly, spreads to distant internal organs, and is fatal. Thickness of melanoma is an important factor for finding the surgical margin. Pigment network is used to find the density for classifying the melanoma, it is the most important dermoscopic structure.Probabilistic Neural Network classifier is used for classifying the stage.***

Index Terms - Melanoma, Skin cancer, Pigment Network, Density, Probabilistic Neural Network classifier

I. INTRODUCTION

Skin cancers are cancers that arise from the skin cell. It is the uncontrolled growth of abnormal skin cell caused due to the UV radiation from the sun, which makes an unrepaired DNA damage to skin cells that triggers mutation or genetic defects cause skin cells to multiply rapidly and form malignant tumors. The main three types of cells in the epidermis (top layer of the skin) are squamous cell (outer part of the epidermis), basal cell (lower part of the epidermis) and melanocytes [1] is the cell that produces the pigment melanin, which gives color to the skin. Melanin protects the deeper layer of the skin from the harmful effects of the sun.

Melanoma [2] is a cancer that begins in the melanocytes, another name of this cancer is malignant melanoma or cutaneous melanoma. This Cancerous cell can produce melanin so it looks brown or black in color, but some melanoma does not produce melanin that looks pink, tan or white in color. It can develop anywhere on the skin commonly occur in neck and face. Melanoma is more dangerous because it can spread to other parts of the body if not treated early. Thickness of melanoma is an important factor for the survival of patient because it can provide correct surgical margin.

The existing methods are Breslow index [3], ABCDE [4], and seven point checklist methods [5]. Breslow index describes how deeply tumor cells have invaded. ABCDE method is the semi quantitative analysis of five dermatologic characteristics found in the skin lesion. The characteristics evaluated by ABCDE rule are Asymmetry (A), Border (B), Color (C), Diameter (D) and Evolving (E), after that, a score is calculated. Seven-point checklist method is based on the analysis of seven dermatologic characteristics found in melanoma. The analyzed characteristics found in this method are divided into major and minor criteria. The major criteria include the change in size, shape and irregular color, a score of 2 is given if these characteristics are shown otherwise the score is 0.The minor criteria include diameter (>7mm), inflammation, oozing and change in sensation. The presence of this features is classified with score 1 and the absent with 0 points. Finally, for getting the final score, all points are added and the result is classified as nevus if the score is less than 3 and as melanoma if the score is more than or equal to 3.These methods have some disadvantages like low accuracy and error in the prediction phase.

The proposed system provides the possibility of early diagnosis of melanoma by classifying it into three stages based on its density.Stage1: Thin (< 0.76mm), Stage 2: Medium (0.76-1.5mm), Stage 3: Thick (>1.5mm) for getting the surgical margin

II. PROPOSED METHOD

The main components of the proposed system are Image acquisition, Preprocessing, Segmentation, Feature extraction, Probabilistic Neural Network classifier for classification. The block diagram for the proposed system is shown below:

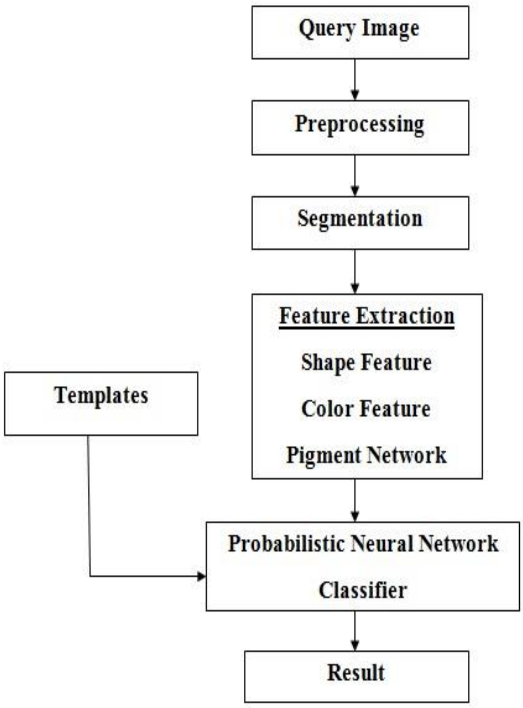

Figure 1: Block Diagram

A. Image Acquisition

Image Acquisition is the first stage of all image processing systems. In this proposed system, the skin lesion analysis is done on dermoscopic images. Dermoscopic images [6] are obtained by dermatoscopy. It is a noninvasive diagnostic technique used to evaluate pigmented lesion to distinguish malignant skin lesion from benign melanocytic naevi. Dermoscopy includes a high-quality lens for 10 to 14 times magnification and a lighting system for the visualization of subsurface structures and patterns. Handheld devices are light weighted and battery powered.Figure.2 shows a sample image captured using dermoscopy.

Figure 2: Dermoscopic Image

B. Pre-Processing

Image pre-processing technique is neccessary for any image based application. In this stage, the image is enhanced for improving the resolution of the image and noise is reduced by using a median filter [7] [8] to improve the result of later processing. All filtering techniques are effectively at removing noise in smooth patches, but it affects edges of the images. By using this median filter it can preserve the edges because edges are important for the visual appearance of images. Figure.3 shows a denoised dermoscopic image.

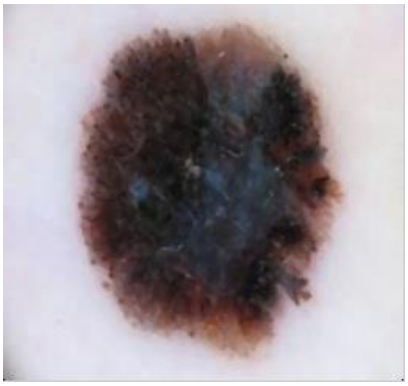

Figure.3: Denoised Dermoscopic Image.

C. Image Segmentation

Segmentation is the process of separating lesion region from the background. Segmentation [9] is done on the dermoscopic image by creating the Region of Interest (ROI), it is usually used as a binary mask to filter out the lesion region for the future operation. Figure.4 shows a masked image and segmented lesion region.

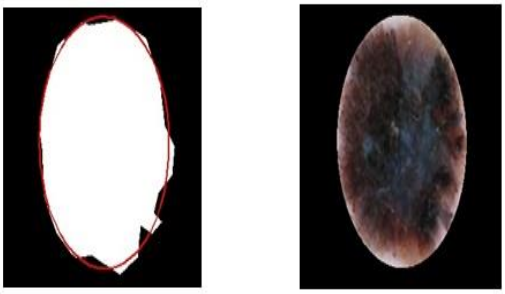

Figure 4: (a) Masked Image and (b) Segmented Lesion Region.

D. Feature Extraction

Features are extracted to analyze the image and to recognize the morphological structures that can indicate melanoma.

(a) Shape Feature

Total area and compactness of the lesion are calculated. The area is calculated by counting the number of pixels inside the border. Eccentricity is calculated as

$$e = \sqrt{1 - \frac{b^2}{a^2}}$$

where a and b are the major and minor axis of the ellipse. An ellipse whose eccentricity is zero is a circle.

(b) Color Features

In color feature, RGB images are converted into CIE L*a*b*[10] color space, developed by International Commission on Illumination. In this stage colors which is not visible to the human eye is removed. L* represent brightness, a* represent the degree of redness & greenish and b* represent the degree of yellowish & bluish. Figure.5 shows lab image of lesion region.

Figure 5: Lab image of lesion region

(c) Pigment Network

The pigment network is a regularly meshed and narrowly spaced network distribution. It is a dermoscopic criterion with high specificity for the diagnosis of melanoma. It is obtained by placing a top hat filter over the CIE color space. Pigment network [11][12] contains holes that are represented as nodes, these nodes are connected by edges according to their distance to from a network. It can extract small element and object brighter than their surroundings. From the pigmented network, density is calculated as

$$\text{Density} = \frac{|E|}{|V| \log(\text{lesion size})}$$

Where E is the number of edges, V is the number of nodes; lesion size is the area of the lesion as number of pixels. Figure.6 shows a pigment network image.

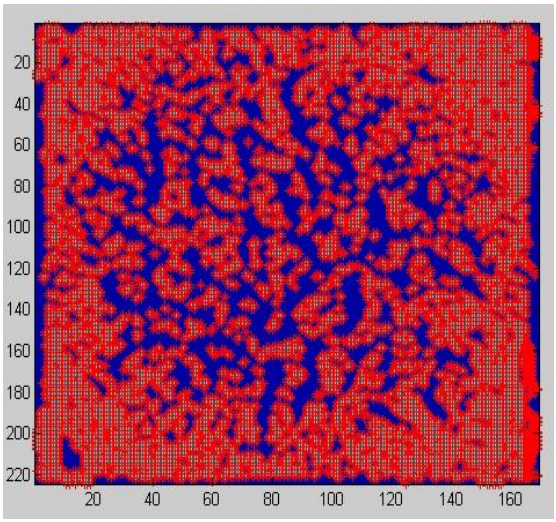

Figure 6: Pigment Network Image

Melanoma is classified as thin, medium and thick based on the density value.

E. Probabilistic Neural Network Classifier

The density value that is obtained through pigment network is given as an input to PNN classifier [13][14]. Figure.7 shows the block of PNN classifier.

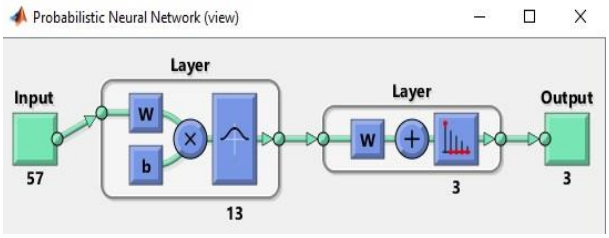

Figure 7: Probabilistic Neural Network

The first layer of PNN classifier computes the distance from the input vector to the training vector. This produces a vector and that indicate how close the input to the training input. The second layer sums the values of each class and produces output as vectors of probabilities. The complete transfer function on the output of the second layer picks the maximum of these probabilities and produces 1 for targeted class and zero for non-targeted class.

F. Result

In this proposed system, PH_2 dermoscopic image database from Pedro Hispano Hospital [15] is used for the experiment. The database contains 200 RGB color image. The Input image is classified as thin because its density value is 0.2250.Figure .8 shows classified image.

Figure 8: Classified Image

III. CONCLUSION

Early diagnosis of melanoma is almost curable. The goal of this paper is to classify the melanoma as thin, medium and thick based on the density value. The main motivation is to ensure the correct surgical margins.

IV. REFERENCES

[1] Bizhan Bandarchi, LingleiMa, Roya Navab, Arun Seth,and Golnar Rasty "From Melanocyte to Metastatic Malignant Melanoma", Dermatology Research and Practice Volume 2010 (2010), Article ID 583748, 8 pages.

[2] A. J. Worth "Growth Patterns in Melanoma and Its Precursor Lesions", Conference paper, DOI: 10.1007/978-3-642-82641-2_1, Gallagher R.P. (eds) Epidemiology of Malignant Melanoma. Recent Results in Cancer Research, vol 102. Springer, Berlin, Heidelberg.

[3]Ashfaq A. Marghoob, M.D. Karen Koenig, Ph.D,Flavia V. Bittencourt, M.D, Alfred W. Kopf, M.D, Robert S. Bart, M.D "Breslow Thickness and Clark Level in Melanoma", CANCER February 1, 2000 / Volume 88 / Number 3, © 2000 American Cancer Society.

[4]P. Carli, V. De Giorgi, D. Palli, V. Giannotti, and B. Giannotti, "Preoperative assessment of melanoma thickness by abcd score of dermatoscopy".Journal of the American Academy of Dermatology, vol. 43, no. 3, pp. 459466, 2000.

[5]H. Haenssle, B. Korpas, C. Hansen-Hagge, T. Buhl, K. Kaune, A. Rosenberger,U. Krueger, M. Schn, and S. Emmert, "Seven-point checklist for dermatoscopy: performance during 10 years of prospective surveillance of patients at increased melanoma risk",Journal of the American Academy of Dermatology, vol. 62, no. 5, pp. 78593, 2010.

[6] M. Emre Celebi, Hitoshi Iyatomi, William V.Stoecker, Randy H. Moss, Harold S. Rabinovitz , Giuseppe Argenziano, H. Peter Soyer, "Automatic detection of blue-white veil and related structures in dermoscopy images", Computerized Medical Imaging and Graphics Volume 32, Issue 8, December 2008, Pages 670–677.

[7] Guoping Qiu "An Improved Recursive Median Filtering Scheme for Image Processing", IEEE Transactions On Image Processing, Vol. 5, NO. 4, APRIL 1996.

[8] Sin Hoong Teoh and Haidi Ibrahim "Median Filtering Frameworks for Reducing Impulse Noise from Grayscale Digital Images: A Literature Survey", International Journal of Future Computer and Communication, Vol. 1, No. 4, December 2012.

[9]Mario Rosario Guarracino, Lucia Maddalena, "Segmenting Dermoscopic Images", National Research Council, Institute for High-Performance Computing and Networking Via P. Castellino 111, 80131 Naples, Italy

[10] C.B. Tatepamulwar, V.P. Pawar, K.S. Deshpande, H. S. Fadewar "Detection and Identification of Human Skin Diseases Using CIE lab Values",© 2015, IJARCSSE All Rights Reserved.

[11] Maryam Sadeghia, Majid Razmara, "A novel method for detection of pigment network in dermoscopic images using graphs", Computerized Medical Imaging and Graphics CMIG-1015; 2014.

[12] C. Barata, J. S. Marques, and J. Rozeira, ''A system for the detection of pigment network in dermoscopy images using directional filters,'' IEEE Trans. Biomed. Eng., vol. 59, no. 10, pp. 2744–2754, Oct. 2012.

[13] Shreepad S. Sawant, Preeti S. Topannavar "Introduction to Probabilistic Neural Network Used For Image Classifications", © 2015, IJARCSSE All Rights Reserved.

[14]D. F. SPECHT, "Probabilistic Neural Networks". Journal of Neural Networks, vol.3, pp.,109-118, 1990.

[15] www.fc.up.pt/addi/ph2%20database.html