Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

International Conference on Mobility in Computing- ICMiC13, Organized by Mar Baselios College of Engineering and Technology during December 17-18, 2013 at Trivandrum, Kerala, India, pg.87 – 94

SURVEY ARTICLE

Implementation of ANN Classifier using MATLAB for Skin Cancer Detection

Aswin.R.B[1], J. Abdul Jaleel[2], Sibi Salim[3]

[1] Dept. of Electrical & Electronic Engineering, Mar Baselios College of Engineering and Technology, Kerala, India

[2,3]Dept. of Electrical & Electronic Engineering, TKM College of Engineering, Kollam, India

aswinrb@gmail.com [1], drjaleel56@gmail.com[2], sibi_salim@rediffmail.com[3]

Abstract — Skin cancer is the deadliest form of cancers in humans. Skin cancer is commonly known as Melanoma. Melanoma is named after the cell from which it presumably arises, the melanocyte. Skin Cancers are of two types- Benign and Malignant Melanoma. Melanoma can be cured completely if it is detected early. Both benign and malignant melanoma resembles similar in appearance at the initial stages. So it is difficult to differentiate both. This is a main problem with the early skin cancer detection. Only an expert dermatologist can classify which one is benign and which one is malignant. The Artificial Neural Network based Classification methodology uses Image processing techniques and Artificial Intelligence for early diagnosis. Main advantage of this computer based classification is that patient does not need to go to hospitals and undergo various painful diagnosing techniques like Biopsy. In this Computer Aided Classification, dermoscopy image of skin cancer is taken and it is subjected to various pre-processing and image enhancement. The cancer affected region is separated from the healthy skin using Segmentation. In order to reduce the complexity of classification, some unique features of malignant and benign melanoma are extracted. 2DWavelet transform is the Feature Extraction Method used. These features are given as the input to the Artificial Neural Network Classifier. It classifies the given data set into cancerous or non-cancerous.

Keywords— Melanoma; Biopsy; Segmentation; 2DWavelet transform; Artificial Neural Network

I. INTRODUCTION

Skin is the outermost covering of human body. It is a protective layer of the body which acts as first line of defense against foreign particles entering into the body. There are many diseases or conditions that affect the skin, one such abnormality occurring in skin is skin cancer. Normal cells grow in a controlled way such that new cells replace the old ones. But in the case of cancer, they grow in an abnormal way. Normal cells become cancerous due to the genetic disorders occurring in the nucleus of the cells by external or internal factors Skin cancer at its early stages can be cured. But when it is not recognized at its early stages, it begins to spread to other parts of the body and can be deadly.

Skin cancer is collectively called as Melanoma. Melanoma is named after the cell from which it presumably arises, the melanocyte. It is the skin cell producing the melanin pigment, which provides protective shielding from Ultraviolet radiations. Melanoma is of two types: Benign Melanoma and Malignant Melanoma [1]. Benign Melanoma is simply appearance of moles on skin. A normal mole is usually an evenly colored brown, tan, or black spot on the skin. It can be either flat or raised. It can be round or oval. Moles are generally less than 6millimetres. Malignant melanoma is the appearance of sores that cause bleeding. Malignant Melanoma is the deadliest from of all skin cancers. It arises from cancerous growth in pigmented skin lesion. If diagnosed at the right time, this disease is curable. But one of the main problems associated with skin cancer detection is the similarity in appearance of Benign and Malignant Melanomas at its early stages. Malignant melanoma starts as a small mole. Most people ignores it by thinking that, it is just a mole. But if it is unchecked, it starts spreading to the other parts of the body and become fatal. So an early detection is of utmost importance in the treatment of melanoma[7].

Biopsy is the conventional method for skin cancer detection. It involves the removal of skin and sample undergoes various laboratory tests. Laboratory sampling often causes the inflammation or even spread of lesion. It is painful also. So, there has always been lack of less dangerous and time-consuming methods. Computer based diagnosis can improve the speed of skin cancer diagnosis which works according to the disease symptoms. There are some unique symptoms of skin cancer, such as: Asymmetry in shape, Border irregularity of lesion, Color variation of lesion and Diameter. Those are popularly known as ABCD parameters: Asymmetry, Border irregularity, Color, Diameter. Asymmetry is one half of the lesion does not match the other half. Border Irregularity is the irregularity of lesions. Color change in the lesion region is irregular, that is a mix of dark, brown and red coloration. Malignant melanoma is having a diameter greater than 6mm. By incorporating these features into the computer based detection system, the early detection of melanoma is made possible [1].

The conventional diagnosing method for skin cancer is biopsy. It is a painful and time consuming technique. By incorporating Artificial intelligence and Digital Image Processing for skin cancer detection, it is possible to do the diagnosis without any physical contact with the skin. This can be implemented in a computer with the help of some software. Skin cancer detection system implemented using computer and software is known as Computer Aided Detection. The detection system is mainly based on Artificial intelligence and Digital Image Processing. Artificial intelligence has proven to be very efficient in decision making and pattern recognition applications. In this paper, the ANN Classifier is implemented in MATLAB software for skin cancer detection.

II. AUTOMATED EARLY SKIN CANCER DETECTION SYSTEM

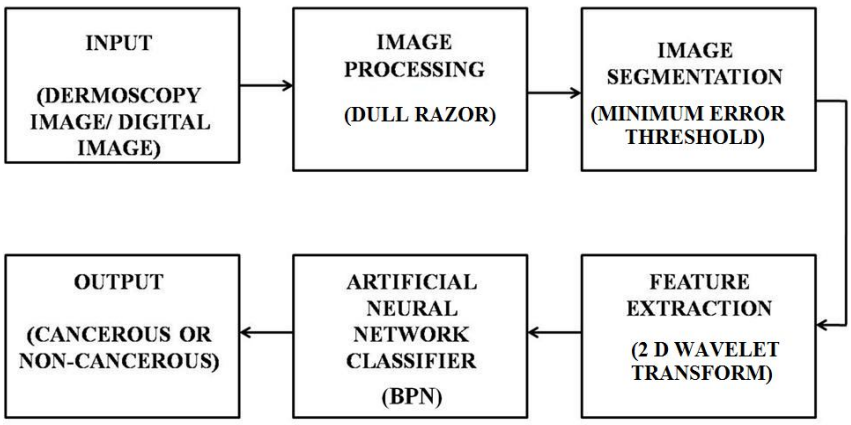
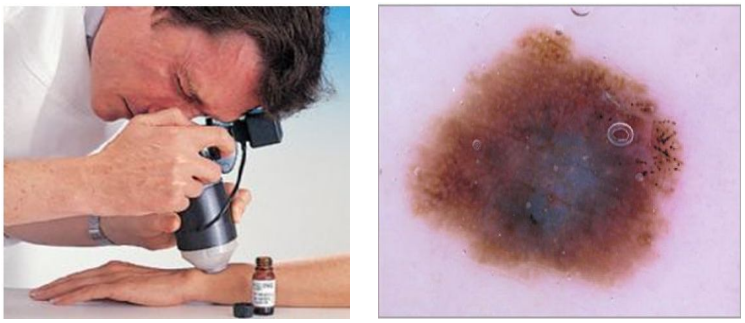


Fig 1. Block diagram representation

First stage in the skin cancer detection system is the input image. Dermoscopic image in digital format is given as input to the system. Next stage is the noise removal. The image contains hairs and other noises. These noises cause errors in classification. The noises are removed by filtering. Filtering method implemented here is the Median Filtering. The image after filtering is subjected to segmentation. Segmentation separates the suspicious lesion from normal skin. There are some unique features that distinguish malignant melanoma from benign melanoma. Those features are extracted using Feature extraction technique. The feature extraction technique used here is 2D Wavelet Transform. The selected features are given as the input to Artificial Neural Network Classifier (ANN). The classifier classifies the given datasets into cancerous and non-cancerous. Figure 1 shows block diagram representation.

A. Dermoscopy

Dermoscopy is an imaging methodology for the exanimation of skin lesions[1]. This method provides a good and detailed view of the lesions. The imaging equipment used for taking the images is Dermatoscope. It is a handheld device which is compact and easy to use. An oil film is placed between the lens of detematoscope and skin lesion. Main purpose of placing oil film is to obtain the magnified view of skin tissues. Lighting is provided from both sides of the equipment so that information about deeper layers and more clear view of the skin tissues are obtained[4].

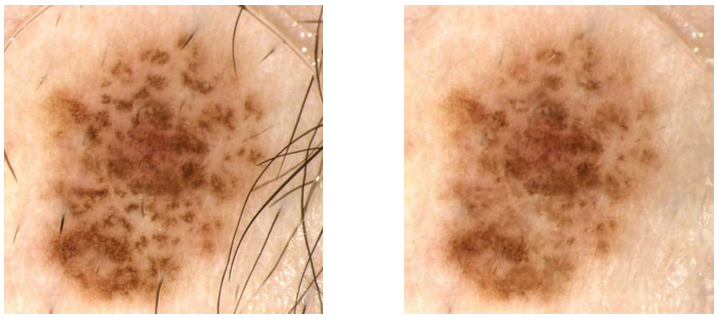


(a) Dermatoscopy (b) Dermatoscopic image

Fig. 2: Dermoscopic method

B. Image Processing

Image processing step involves two processes. First hair removal is done and after that, filtering is done to remove any additional noises present in the image. Hair removal is done using Dull Razor software. The dermoscopic images may contain hairs. These hairs somehow will give erroneous classification. So it is desirable to do the hair removal before proceeding to further steps. Dull Razor software [10] is a medical imaging software for hair removal. In this, a special type of filter is used, which replaces hair pixels by neighboring pixels. It improves classification results. Even after hair removal, there may be some noises present in the image. Air bubbles, scratches in the skin etc. constitutes the noises. These noises are removed using Filtering. Filtering technique adopted here is Median Filtering. It is an image filtering method in which each pixel value in an image is replaced with the median value of its neighboring pixels including itself. Median filtering is used for minimizing the influence of small structures like thin hairs and isolated islands of pixels like small air bubbles.

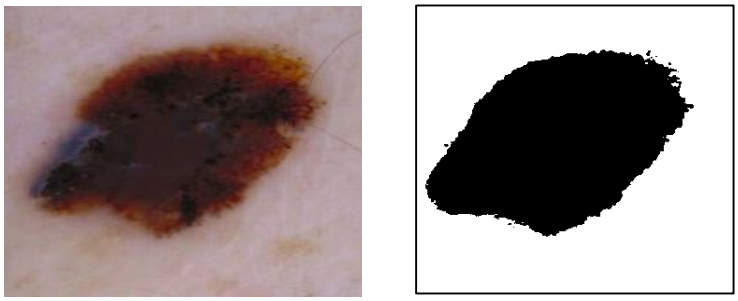


(a) Dermoscopic image containing hairs (b) Hairs removed using Dull Razor

Fig. 3: Hair removal using Dull Razor Software

C. Segmentation

Image thresholding is an important technique for image processing and pattern. Bi-level thresholding classifies the pixels of an image into two classes [3], one including those pixels with gray-levels above a certain threshold, the other including the rest. The pixels will be either classified into one of the two classes. While classifying the pixels, there may be a chance of errors like, some of the pixels in background class may come into object class and vice versa. Minimum error thresholding method, finds the optimum threshold by optimizing the average pixel classification error rate directly, using either exhaustive search or an iterative algorithm [8]. This method assumes that an image is characterized by a



mixture distribution with the population of object and background classes are normally distributed. In this paper, the object class taken is the skin lesion and the background class is the normal skin. Pixels will be classified into one of the two classes. A threshold level is selected in such a way that the error in classification is minimum. Using this threshold, segmentation is performed. Segmentation is done using IMAGE J software.

(a) Dermoscopic image after hair removal (b) Segmented Image

Fig. 4. Minimum Error Threshold Segmentation

D. Feature Extraction

Feature extraction is the method by which unique features of skin lesion images are extracted. This method reduces the complexity in classification problems. There certain features like geometry and color which distinguish melanoma from benign lesions. By extracting those features and training ANN classifier using known features, the classification can be made more efficient. The feature extraction method performed here is 2D wavelet transform [2] [5]. 2-D wavelet packet is used and the enhanced image in gray scaled as an input [6]. Bio wavelets at two steps of decomposition are used. At each step of decomposition, the wavelet of primary image is divided into an approximate and three detailed images which show the basic information and vertical, horizontal and diagonal details, respectively. The Features

extracted using the wavelet transform are: Mean, Standard deviation, Mean Absolute Deviation, L1 Norm, L2 Norm [9]. Along with these features, two additional features are taken – Skewness and Kurtosis. Skewness is a measure of asymmetry. A dataset, is symmetric if it looks the same to the left and right of the center point. Melanoma is having asymmetrical shape whereas benign lesion is symmetrical. Kurtosis is a measure of whether the data are peaked or flat relative to a normal distribution. The feature extraction is performed in MATLAB software.

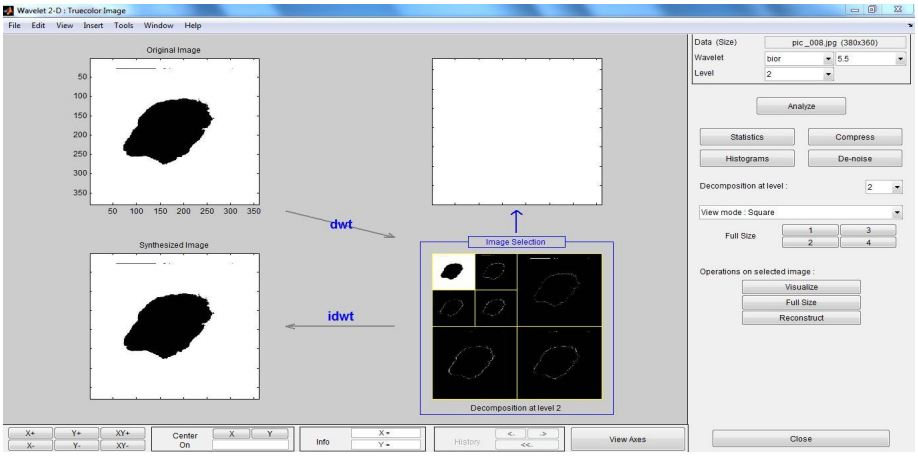


Fig. 5. Feature Extraction using 2D wavelet Transform in MATLAB

E. ANN Classifier

A classifier classifies the given datasets into cancerous and non-cancerous. Here a computer based classifier implemented in MATLAB software is used for classification purpose. Since there are 7 features, the classifier network consists of 7 inputs. Number of hidden neurons taken is 4 and one output neuron. The activation function used is tan sigmoid function. The output of the network is 0 or 1. Zero indicates a non-cancerous or benign condition and One indicates Cancerous condition or malignant melanoma condition. The classifier is designed in MATLAB software. ANN is trained using Back propagation algorithm, by giving known values of features and desired output. Weights are initialized randomly. During each epoch, the weights are updated so that error between desired output and actual output is minimum. Fifty image datasets were taken for classification.

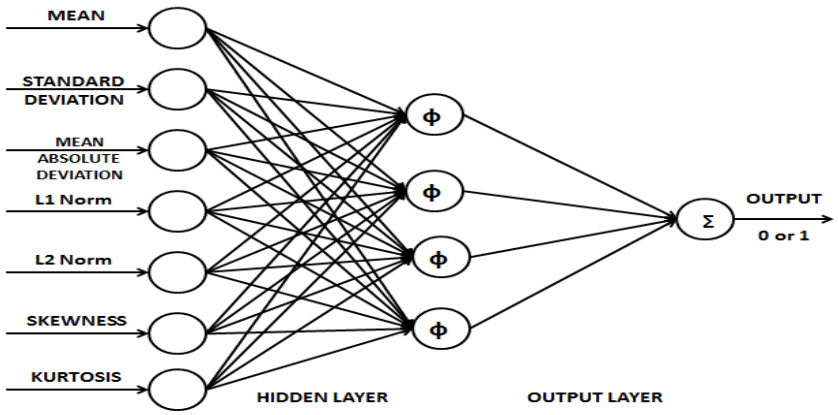


Fig. 6. ANN Classifier structure

III. RESULTS

The ANN classifier is setup in MATLAB software. It is trained using known datasets and desired outputs. After mean square error reaches a minimum value, the training is stopped. Then fifty datasets were given as inputs to the network, for classification. The classifier classifies the given datasets into cancerous and non-cancerous. The obtained results were compared with the clinical diagnostic results of a dermatologist. It is found that there were 8 misclassifications. So the accuracy of the system is 84%. The confusion matrix shows the errors in the classification. Also the classified outputs are obtained in the MATLAB window. It is shown in figures 8 and 9.

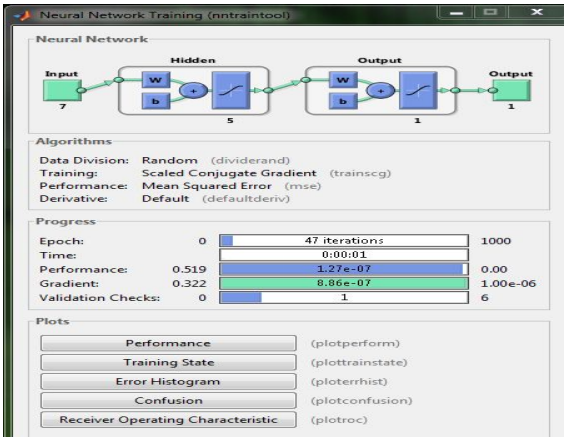


Fig. 7. ANN training in MATLAB

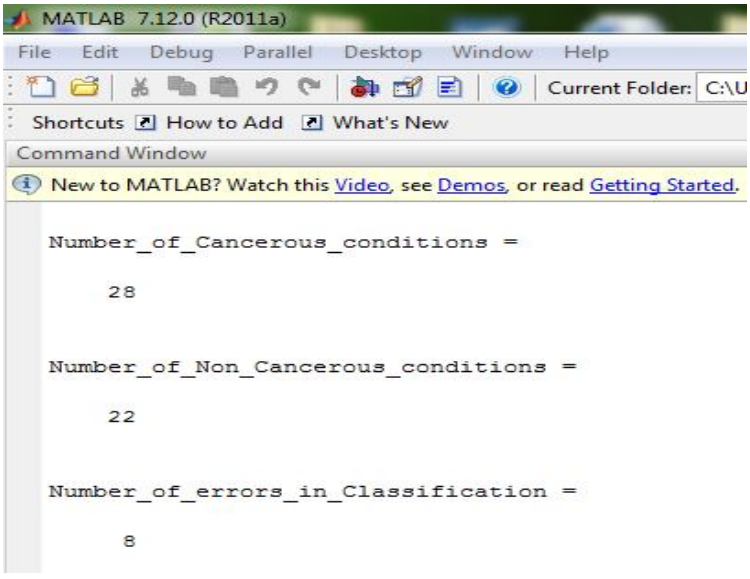


Fig. 8. MATLAB window showing classification results

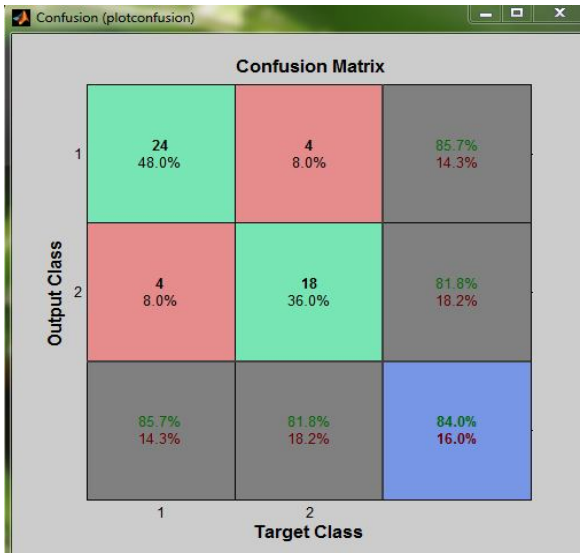


Fig. 9. Confusion Matrix showing results of classification

CONCLUSION

Early skin cancer diagnostic system using computer based techniques is more efficient than the conventional Biopsy methods. The cost involved as well as the time taken for detection is less in this proposed methodology. The methodology incorporates Artificial Intelligence and Digital Image Processing for skin cancer detection. ANN based classifier proved to be very efficient in decision making as well as pattern recognition applications. The proposed method has an accuracy of 84%, which is much higher than that of conventional methods.

ACKNOWLEDGMENT

We would like to thank all the faculties and students of Electrical and Electronics Engineering Department, Thangal Kunju Musaliar College of Engineering management for their support and facilities extended to us. Also we would like to thank all the faculties of Electrical and Electronics Engineering Department of Mar Baselios College of Engineering and Technology, for their support and encouragement.

REFERENCES

[1] Ho Tak Lau and Adel Al-Jumaily, "Automatically Early Detection of Skin Cancer: Study Based on Neural Network Classification", International Conference of Soft Computing and Pattern Recognition, IEEE , pp 375-380, 2009

[2] Ali AI-Haj, M.H.Kabir "Wavelets Pre-Processing of Artificial Neural Networks Classifiers" , IEEE Transactions on Consumer Electronics, Vol. 53 Issue 2, pp. 593-600 , 2008.

[3] Pankaj Agrawal, S.K.Shriwastava and S.S.Limaye, "MATLAB Implementation of Image Segmentation Algorithms", IEEE Pacific, pp.68–73.

[4] T. Tanaka, R. Yamada, M. Tanaka, K. Shimizu, M. Tanaka, "A Study on the Image Diagnosis of Melanoma", IEEE Trans. on Image Processing, pp. 1010-1024, June 2004.

[5] Y. Andreopoulos, N. D. Zervas, G. Lafruit, P. Schelkens, "A local wavelet transform implementation versus an optimal row-column algorithm for the 2D multilevel decomposition", IEEE International Conf. on Image Processing, volume 3, 2001.

[6] Shubhankar Ray and Andrew Chan, "Automatic feature extraction from wavelet coefficients using Genetic Algorithms", IEEE Transactions on Image Processing, pp. 980-1025, June 2000.

[7] FikretErcal, Anurag Chawla, William V. Stoecker, Hsi-Chieh Lee, and Randy H.Moss, "Neural Network Diagnosis of Malignant Melanoma from Color Images", IEEE Transactions on Biomedical Engineering. vol. 41, No. 9, 1994
[8] Mariam A.Sheha,Mai S.Mabrouk, Amr Sharawy, "Automatic Detection of Melanoma Skin Cancer using Texture Analysis," International Journal of Computer Applications, Volume 42, 2012
[9] M. Vetterli, O. Riol, "Wavelets and Signal processing" IEEE Signal Processing Magazine, Oct 1991, pp.14-38.
[10] Lee T, Ng V, Gallagher R, Coldman A, McLean D, " DullRazor: A software approach to hair removal from images". Computers in Biology and Medicine 1997;27:533-543.

