International Journal of Innovations in Engineering and Technology (IJIET)
http://dx.doi.org/10.21172/ijiet.144.03

Automated skin disease detection using multiclass PNN

Manisha Barman[1], J. Paul Chaudhury[2], Sushanta Biswas[3]
[1]*Department of Information Technology, Kalyani Govt.Engg.College, Kalyani, West Bengal, India*
[2]*Department of Information Technology, Future Institute of Engg. & Management, Sonarpur, Kolkata,West Bengal, India*
[3]*Dept. of Engineering & Technological Studies, University of Kalyani, Kalyani, West Bengal, India*

Abstract- Now a days skin cancer is widely spread in our society.It is very a much common disease all over world . One of the important category of skin cancer is named melanoma cancer. The primary risk factor for melanoma and non-melanoma cancers is exposure to ultraviolet (UV) light, including sunlight and tanning beds,with the risk growing with the amount of exposure. People who live in areas with bright, year-round sunlight, or those who spend a lot of time outdoors without protective clothing or sunscreen, are at greater risk. Early exposure, particularly for people who had frequent sunburns as a child, also increases skin cancer risks. The objectives of this paper is to develop an algorithm for detecting the skin disease by simple and less time consuming generated system.We design a classification algorithm based on multiclass Probabilistic Neural Network (PNN) to classify two effective skin disease-melanoma and vitiligo. To address the problem we construct a data set contains 500 images of human normal and effected skin with melanoma and vitiligo. We use the median filter as a noise removal of input images. Intensity histogram, GLCM, and Discrete Fourier Transformation (DFT) features are used as trained and tested values. Based on these values PNN is trained and use to classify normal, melanoma affected and vitiligo affected skin. The result of our proposed method shows more than 85% accuracy and it should be concluded that the Probabilistic neural network plays a very good role to classify the disease other than any classification algorithm.

Keywords – Digital image, histogram features, GLCM, DFT, probabilistic neural network, confusion matrix.

I. INTRODUCTION

Melanoma is a cancer that begins in the melanocytes. Most melanoma cells still make melanin, so melanoma cancers are usually brown or black. But some melanomas do not make melanin and can appear pink, tan, or even white. Melanomas can develop anywhere on the skin, but they are more likely to start on the trunk (chest and back) in men and on the legs in women. Similarly vitiligo is a skin problem that occur due to lose of pigment in skin areas. Main symptom of vililigo is white-milky irregular patches in any parts of the body. It affects any gender and any age group of people. Today there is no proper solution for this type of dieses though worldwide research is going on. The prediction disease using image processing tools along with soft computing models has been attempted by many researchers.

Shivangi Jaina et. al [1]have used to present a computer aided method for the detection of melanoma Skin Cancer using Image Processing tools. The input to the system is various types of s kin cancer such as melanoma, basal and squamous cell carcinoma among which Melanoma is the most unpredictable. The detection of Melanoma cancer in early stage can be helpful to cure . The Lesion Image analysis tools checks for the various Melanoma parameters Like Asymmetry, Border, Colour, Diameter,(ABCD) etc. by texture, size and shape analysis for image segmentation and feature stages. The extracted feature parameters are used to classify the image as normal skin and melanoma cancer lesion.

Fikret Ercal,et. al[2] have used develop a novel neural network approach for the automated separation of melanoma from three benign categories of tumors which exhibit melanoma-like characteristics. They have used discriminant features, based on tumor shape and relative tumor color, that are supplied to an artificial neural network for classification of tumor images as malignant or benign. With this approach, for reasonably balanced training testing sets, able to obtaina bove 80% correct classification of the malignant and benign tumors on real skin tumor image.

J. H. JaseemaYasmin, M. Mohamed Sadiq[3] have used an automated system for segmentation of colored skin images which has helped the early detection of malignant melanoma. Skin images have comprised of four major components: skin image acquisition, lesion segmentation, feature extraction, and lesion classification. Automatic segmentation of lesions in color skin images is the main focus of this paper This technique is one of the most important steps towards the automated analysis and evaluation of dermoscopy of images in the computer aided diagnosis of melanoma. The accuracy of segmentation is highly dependent on the success or failure of each computerized analysis procedure. An improved iterative segmentation algorithm using canny edge detector with iterative median filter is presented for border detection of real skin lesions,which has helped in early detection of

malignant melanoma.Its performance is compared with the segmentation algorithm using canny detector. Finally the authors have shown that their result is excellent.

Nidhal K. EL Abbadi and Zahraa Faisal [4] have developed automatic methods in order to increase the accuracy of the diagnostic. In this paper, initially skin images ware filtered to remove unwanted particles, then a new method for automatic segmentation of lesion area was carried out based on Markov and Laplace filter to detect lesion edge, followed by convert image to YUV color space, U channel would be processed to remove thick hair and extract lesion area. Diagnosis of melanoma achieved by using ABCD rules with new method for determine asymmetry based on rotation of lesion and divide lesion to two parts horizontally and vertically then count the number of pixels mismatched between the two parts based on union and intersection between the two parts. New method to determine the number of colors based on suggestion of color regions for each color shade was suggested in this paper. The performance of the proposed method was tested on 220 different images. Accuracy for this method was encourage and reach up to 95.45%. The proposed method showed best accuracy when compared with other methods.

Seema Kolkur,VidyaKharkar et.al [5]developed a system which identifies the disease based on input symptoms.They have acquired symptoms data of 10 skin diseases with the help of expert doctor in the field. Different types of classifiers SVM, ANN, random forest, decision tree and KNN algorithm were trained on the symptom's data that produced 90% above accuracy.

L. G. Kabari and F. S. Bakpo, et. al [6] have to deal with the construction and training of an artificial neural network for Skin Disease Diagnosis (SDD) based on patients' symptoms and causative organisms. The artificial neural network constructed using a feed-forward architectural design was shown to be capable of successfully diagnosing selected skin diseases in the tropical areas such as Nigeria with 90 percent accuracy. The work may in the future serve as a knowledge base for an expert system specializing in medical diagnosis, testing evaluation, treatment evaluation, and treatment effectiveness. The work served as the first component of a much larger system that will assist physicians facilitate the reasonable ordering of tests and treatments and minimize unnecessary laboratory routines while reducing operational costs. The proposed system was able to achieve a high level of success using the artificial neural network technique. A success rate of 90% was achieved. This infers that ANN technique was an effective and efficient method for implementing diagnostic problems.

Sanjay Jaiswar, Mehran Kadri, VaishaliGatty[7]have to discussed that as the detection of Melanoma cancer in early stage can be helpful to cure it. Computer vision can play important role in Medical Image Diagnosis and it has been proved by many existing systems. In this paper, we present a computer aided method for the detection of Melanoma Skin Cancer using Image processing tools. The input to the system is the skin lesion image and then by applying novel image processing techniques, it analyses it to conclude about the presence of skin cancer. The Lesion Image analysis tools checks for the various Melanoma parameters Like Asymmetry, Border, Colour, Diameter, (ABCD) etc. by texture, size and shape analysis for image segmentation and feature stages. The extracted feature parameters are used to classify the image as Normal skin and Melanoma cancer lesion. There is very small number of research work has been carried out.

Here in this paper it has been proposed to develop an automated skin disease detection system for recognizing the particular disease conditions of human skin with the techniques of image processing and soft computing techniques. The proposed works has been divided into four parts, Image pre-processing, feature extraction, evaluation of the feature set using PNN classifier and create a confusion matrix. Here it is proposed to take two types of skin images from normal skin image and affected skin images. Thereafter region of interest from the image of skin has to be taken and color conversion have been done for both skin images. Feature extraction methodologies analyse objects and images to extract the most prominent features that are representative of the various classes of objects. Features are used as inputs to classifiers that assign them to the class that they represent. In this work intensity histogram features and gray level co-occurrence matrix(GLCM)and discrete fourier transform(DFT)features are Extracted. After calculating the histogram feature probabilistic neural network have been applied. The said result has to be crosschecked by applying GLCM co occurrence matrix and DFT.

II. METHODOLOLY

In proposed system three different features have been used. One is histogram analysis has been extensively researched in the initial stages of development of this algorithm. Prior studies have yielded the intensity histogram features like mean, variance, Standard daviation, skewness, kurotosis etc. Another is gray-level co-occurrence matrix (GLCM).It is a texture feature that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. By default, the spatial relationship is defined as the pixel of interest and the pixel to its immediate right (horizontally adjacent), but can specify other spatial relationships between the two pixels. Each element (I, J) in the resultant GLCM is simply the sum of the number of times that the pixel with value I occurred in the specified spatial relationship to a pixel with value J in the

input image. The Following GLCM features were extracted in our research work. These are contrast, correlation, homogeneity, energy etc. DFT, discrete fourier transform is a technique of extraction of feature vector. The flow diagram of proposed system has been furnished below in fig 1.

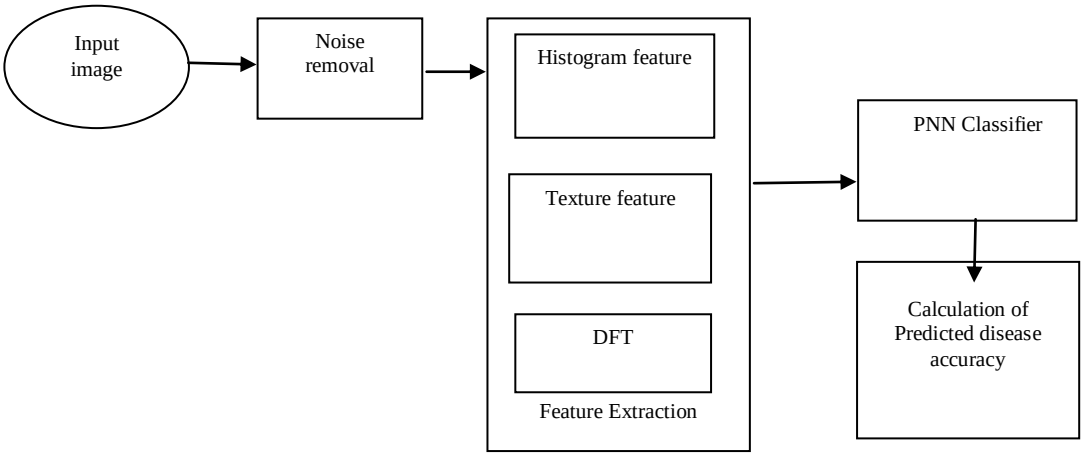

Fig:1 Flow diagram of proposed work

2.1 Histogram Features:

Name	Description	Formulae
Mean	the average value of numerical data.	$X = \frac{\sum x_i}{n}$ Where X stands for sample mean, Σ x stands for add up for all X values and n the number of items in the sample.
Variance	expectation of the squared deviation of a random variable from its mean, represented by δ2 .{\displaystyle \sigma ^{2}}{\displaystyle \operatorname {Var} (X)}	$\delta^2 = \frac{\sum(X-\mu)^2}{n}$ Where stands for sample variance,sum of the squared distances of each term in the distribution from the mean (μ), divided by the number of terms in the distribution (n).
Standard Daviation	measure of the amount of variation or dispersion of a set of values.	$Sd = \sqrt{\frac{(r_i - ravg}{n-1}}$ Sd Where stands for sample standard daviation ,rithe return observed in one period (one observation in the data set), ravg the arithmetic mean of the returns observed ,n the number of observations in the dataset
Skewness	measure the asymmetry of a probability distribution of random variables about its own mean and its value can be positive, negative or undefined.	$Sk = \frac{\sum_i^n (Xi-\mu)^3}{(n-1) * \sigma 3}$ Where stands for sample skewness Xi = ith Random Variable = Mean of the Distribution n = Number of Variables in the Distribution, Ơ = Standard Distribution
kurtosis	measure of the "tailedness" of the probability distribution of a real-valued random variable	$Z = \frac{X-\mu}{\delta}$ Where stands for sample kurtosis, X is a random variable, μ is the mean and σ is the standard deviation

2.2GLCM Co-occurrence Matrix

Name	Description	Formulae
Contrast	Measures the local variations in the gray-level co-occurrence matrix.	$I_1 = \sum_{i}^{L-1} \sum_{j}^{L-1} (i-j)^2 [g(i,j)]$
Corelation	Measures the joint probability occurrence of the specified pixel pairs.	$I2 = \frac{\sum\sum(i - x)(j - y)g(i,j)}{\sigma_x \sigma_y}$
Homogenity	Measures the closeness of the distribution of elements in the GLCM to the GLCM diagonal.	$I3 = \sum_{i}^{L-1} \sum_{j}^{L-1} \frac{1}{(i-j)^2+1} g(i,j)$
Energy	Provides the sum of squared elements in the GLCM. Also known as uniformity or the angular second moment.	$I_4 = \sum_{i=0}^{L-1} \sum_{j=0}^{L-1} [g(i,j)]^2$

2.3Discrete Fourier Transform(DFT)

Discrete Fourier transform is mainly used in image enhancement and prepressing and image compression. But today it is used as a feature extraction method[12][13]. The DFT method has been used to the skin images and then selects some of the coefficients to construct feature vectors in a zig zag manner. Those coefficient having global information have been chosen. For an image with dimension AxB DFT co efficient has been calculated as

$$F(k,l) = \sum_{m=0}^{A-1} \sum_{n=0}^{B-1} I(m,n)\, X\, e^{-j\frac{2\pi mx}{M}}\, e^{-j\frac{2\pi my}{N}} \quad \text{where } j = \sqrt{-1}$$

2.4 Probabilistic Neural Network (PNN)

Probabilistic Neural Network is feedforward neural network, which is widely used in classification and pattern recognition problems. It is based on parametric probabilistic distribution function the operations are organized into a multilayered feedforward network with four layers:1) Input layer 2)Pattern layer 3) Summation layer 4) Output layer. When an input is present, the first layer computes the distance from the input vector to the training input vectors. This produces a vector where its elements indicate how close the input is to the training input. The second layer sums the contribution for each class of inputs and produces its net output as a vector of probabilities. Finally, a compete transfer function on the output of the second layer picks the maximum of these probabilities.PNN is a type of ANN is derived from the Bayesian network and a statistical algorithm.

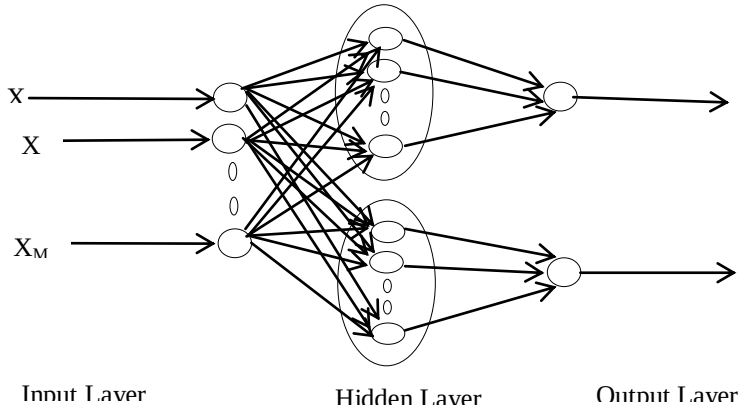

Fig:2 Working principle of PNN network

III. IMPLEMENTATION AND RESULT

Step1: Conversion of RGB image to Gray image.
Skin images have been collected from the dermnet.com [9]. Snap shot of the selected sample input images in the original in RGB form have been converted into gray form. The corresponding pixel value has been used in step 2.
Step 2: Selection of Region of Interest

A lot of samples have been taken to find out some deformity in these samples.
From the selected image the region of interest has been taken.
Step 3: Median filter is used to reduce impulsive noise with preserving the useful features and image edges.
Step 4: Calculation of Feature value.

The histogram features and GLCM features have been calculated. And furnished in table 1 and table 2

Table no 1 histogram features

Sample image	mean	variance	Standard daviation	Skewness	Kurtosis	Type of image
sample1.jpg	73.3113	256.4871	5.0225	0.7108	3.2438	Melanoma Affected
sample20.jpg	116.6934	422.8771	5.0434	1.0323	3.7071	Melanoma Affected
sampleV-3.jpg	188.3652	281.7950	1.5534	-0.1088	1.9599	Vitiligo Affected
sampleV-15.jpg	171.0769	185.6310	3.6955	-0.1934	4.9672	Vitiligo Affected
SN-1.jpg	228.9935	14.3241	0.9325	-0.6251	3.1326	Normal skin
SN-6.jpg	179.2383	12.3943	0.4820	-0.2855	3.6145	Normal skin

Table no 2 GLCM features

Sample image	Contrast	Correlation	Energy	Homogeneity	Type of image
sample1.jpg	0.1122	0.8794	0.3479	0.9539	Melanoma Affected
sample20.jpg	0.1765	0.5704	0.4472	0.9118	Melanoma Affected
sampleV-3.jpg	0.1976	0.7192	0.3146	0.9012	Vitiligo Affected
sampleV-15.jpg	0.0976	0.7312	0.5989	0.9512	Vitiligo Affected
SN-1.jpg	0.0051	0.6582	0.9805	0.9975	Normal skin
SN-6.jpg	0.0063	0.7126	0.8214	0.9669	Normal skin

Step5: calculation of DFT features using equation and create the feature vector
Step6: Training with the Probabilistic Neural Network. For every individual parameter a separate Probabilistic Neural Network has been constructed and trained accordingly. For this proposed algorithm twelve numbers of PNN network has been constructed to produce the result.
Step 7: After getting tested result Confutionmatix has been created.Four important measurements have been used to determine the performance of proposed algorithm. The measures are accuracy, sensitivity, specificity and precision.

$$accuracy = \frac{T_p + T_n}{T_p + F_p + F_n + T_n}$$

$$Sencitivity = \frac{T_p}{T_p + F_n}$$

$$Specificity = \frac{T_n}{F_p + T_n}$$

$$precision = \frac{T_p}{T_p + F_p}$$

Where Tp,Tn,,Fp and Fn represent true positive , true negative, false positive and false negative respectively.

Result
To analysis the performance of proposed method a data set of 550 input image have been applied to the proposed method that detect not affected skin, melanoma affected skin and vitiligo affected skin. The result of the proposed method has been furnished in table 3 and in table 4. Overall accuracy of proposed method is nearly 86%.

Table no 3 Confusion matrix

Predicted	Non effected	vitiligo	melanoma
Non affected	158	10	12
vitiligo	11	151	13
melanoma	15	12	153

Table 4 Classwise precision, sensitivity and specificity result

Actual	precision	sensitivity	specificity
non Effected	0.86	0.88	0.93
vitiligo	0.87	0.86	0.94
melanoma	0.86	0.85	0.93

IV. CONCLUSION

In our proposed method, we have introduced a machine-learning tool that can effectively classify two important skin diseases. Images of affected skin by these diseases are very similar to look. To the best of our knowledge, this is the first attempt that classifies vitiligo and melanoma using Probabilistic Neural Network (PNN). Performance analysis of our proposed model is done by widely used machine learning parameters. Using PNN we have proven that our proposed model has more than 86 % accuracy, simple, effective and it has low complexity which is very satisfactory. In the future, we should develop a better classification approach for better recognition accuracy.

V. REFERENCE

[1] Shivangi Jaina, Vandana jagtapb, Nitin Pisea, Computer aided Melanoma skin cancer detection using Image Processing, International Conference on Intelligent Computing, Communication & Convergence (ICCC-2014), Procedia Computer Science 48 (2015) 735 – 740

[2] Fikret Ercal,Anurag Chawla, William V. Stoecker,Hsi-Chieh Lee, and Randy H. Moss,Neural Network Diagnosis of MalignantMelanoma From Color Images,IEEE Transaction on biomedical engineering,vol. 41, no. 9, Seyiember 1994,page-837-845

[3] J. H. JaseemaYasmin, M. Mohamed Sadiq;"An Improved Iterative Segmentation Algorithm using Canny Edge Detector with Iterative Median Filter for Skin Lesion Border Detection',International Journal of Computer Applications, (IJCA),Vol 50 number 6,July, 2012, ISSN 0975 – 8887,page no 37–42.

[4] Nidhal K. EL Abbadi,ZahraaFaisal,"Detection and Analysis of Skin Cancer from Skin Lesions',International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 19 (2017) pp. 9046-9052

[5] SeemaKolkur , D.R. Kalbande,VidyaKharkar,Machine Learning Approaches to Multi-Class Human Skin Disease Detection,International Journal of Computational Intelligence Research ISSN 0973-1873 Volume 14, Number 1 (2018), pp. 29-39 © Research India Publications http://www.ripublication.com

[6] L. G. Kabari and F. S. Bakpo ," Diagnosing Skin Diseases Using an Artificial Neural Network,978-1-4244-3523-4 /09/$25.00 c 2009 IEEE, 2009 2nd International Conference on Adaptive Science & Technology,page-187-191

[7] Sanjay Jaiswar, Mehran Kadri, VaishaliGatty, "Skin Cancer Detection Using Digital Image Processing", International Journal of Scientific Engineering and Research (IJSER) Impact Factor (2014): 3.05 Volume 3 Issue 6, June 2015

[8] M.Vasantha,V.SubbiahBharathi, R.Dhamodharan,"Medical Image Feature, Extraction, Selection And Classification",International Journal of Engineering Science and Technology Vol. 2(6), 2010, 2071-2076

[9] www.dermnet.com

[10] Anuradha.K, K. Sankaranarayanan,"Statistical Feature Extraction to Classify Oral Cancers",Journal of Global Research in Computer Science,Volume 4, No. 2, February 2013

[11] Cecilia Di Ruberto and Giuseppe Fodde,"Evaluation of Statistical Features for Medical Image Retrieval",A. Petrosino (Ed.): ICIAP 2013, Part I, LNCS 8156, pp. 552–561, 2013. c Springer-Verlag Berlin Heidelberg 2013,page-552-561.

[12] D. Assefa, et al., "Local quaternion Fourier transform and color image texture analysis," Signal Processing, vol. 90 (6), pp. 1825-1835, 2010.

[13] X.-Y. Jing, et al., "Face recognition based on discriminant fractional Fourier feature extraction," Pattern Recognition Letters, vol. 27 (13), pp. 1465-1471, 2006

[14] Nibaran Das1, Anabik Pal , Sanjoy Mazumder , Somenath Sarkar, An SVM based skin disease identification using Local Binary Patterns, 2013 Third International Conference on Advances in Computing and Communications, 978-0-7695-5033-6/13 $26.00 © 2013 IEEE,page 208-211

[15] Esra Mahsereci et al. Texture analysis of Melanoma Images for Computer-aided Diagnosis, Annual Int'l Conference on Intelligent Computing, Computer Science & Information Systems (ICCSIS-16) April 28-29, 2016 Pattaya

[16] Damilola A. Okuboyejo, Oludayo O. Olugbara, and Solomon A. Odunaike,Automtaic skin disease diagonosis using image classification,

[17] Proceedings of the World Congress on Engineering and Computer Science 2013 Vol II WCECS 2013, 23-25 October, 2013, San Francisco,

[18] Aswin.R.B, J. Abdul Jaleel, Sibi Salim, Implementation of ANN Classifier using MATLAB for Skin Cancer Detection, 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.