International Scientific Journal of Contemporary Research in Engineering Science and Management.
ISSN: 2456-1134

Vol.No:03
Issue:04

Received:15/12/2018 Revised:15/01/2019 Accepted: 15/02/2019

Novel Framework for skin cancer detection CAD System and importance of efficient machine learning model

S Mohan Kumar[1] ,Dr T. Kumanan[2]

Research Scholar, MAHER, Meenakshi University, Chennai, & Associate Professor, New Horizon College of Engineering, Bangalore[1], India, E-Mail:drsmohankumar@gmail.com
Principal, Faculty of Engineering and Technology, MAHER, Meenakshi University, Chennai, India[2]

Abstract - Skin cancer is a disease in which the diagnosis is very complex in nature. We propose a technique for detecting melanoma skin cancer which involves the segmentation of the lesion from the entire image using the otsumethod.The Boundary tracing algorithm has been used for further segmentation. After extracting the features from the lesion, classification is done using the ABCD method. The results obtained are presented in the form of statistical tables and graphs. The experimental result shows that the proposed algorithm makes good for detecting different stages of skin cancer.

Keywords:**Melanoma, Classifier, Segmentation, Image Processing, Texture Analysis, Edge Detection, ABCD Feature Selection, CAD, Boundary Tracing Algorithms,OtsuMethod,Lesion,Classification,SkinCancer,Convolutional Neural Network,Artificial Intelligence.**

1. Introduction

Skin cancer is one of the deadliest form of cancer if detection at an early stage is not done. Skin lesions may be further classified as benign melanoma and malignant melanoma which is termed as skin cancer. Our skin acts as a protective covering in our body and shields urform heat, sunlight, injury, and infection. Skin cancer is the most common type of cancer. Excessive exposure of our skin to the UV rays from the sun leads to skin cancer. The fair complexioned population has been more at risk to develop melanoma. Diagnosis at an early stage improves the chances of proper treatment and cure which otherwise may be fatal. Each year close to 55,000 people are diagnosed with this type of cancer. Compared to other forms of cancer skin cancer has a high occurrence the automatic diagnosis tool will play a vital role in fighting the disease at a very early stage. Even when an accomplished dermatologist uses the dermoscopy for diagnosis, the exactness of melanoma recognition is estimated to be about 75-84%. The computer aided diagnosis ensures diagnosis accuracy as well as the speed.[17]Although Computer cannot be termed as brilliant when compared to human but may be able to obtain some information like color variation, asymmetry and texture features that may not be readily perceived by human eyes.Thegeneral approach of developing a CAD system for the diagnosis of skin cancer is to find the location of a lesion and also to determine an estimate of the probability of a disease.

The first step in this paper was to establish a standard general scheme of a CAD system for skin lesions.

In recent years, Image processing techniques have been used by many researchers to detect melanoma. Image processing plays a vital role for producing digital images with good brightness/contrast and detail is a strong requirement in medical field like vision, biomedical image analysis, cancer detection and orthopedics for the early diagnosis of melanoma[9].It is requirement for image acquisition to be performed on digital images. In this process every pixel is assigned by a label, which will share same visual behaviors. Early stage detection of skin cancer needs computer aided detection. Generally, doctors use biopsy method forthe diagnosis of skin cancer. Biopsy is the removal or scrapping off the skin and those skin samples are undergone many laboratory test hence it is time consuming and painful 7. There are many features or sign of skin cancer such asblue-white veil, multiple brown dots, psuedopods, radial streaming, scar-like depigmentation, globules, multiplecolors, multiple blue gray dots, pigmented network It has the difficulties of over segmentation because of the textured lesion area.[3] In this paper we propose a technique to detect skin cancer and compare with some standard reference values. It has been noted that our algorithm promises better results. Here we discuss about an approach to detect skin cancer and then as a subsequent step extract the selected features.

Discusses a cluster-outlier iterative detection algorithm, tending to detect the clusters and outliers in another perspective for noisy data sets. In this algorithm, clusters are detected and adjusted according to the intra-relationship within clusters and the inter-relationship between clusters and outliers, and vice versa. The rest of the paper is organized as follows. Section 2 reviews related work in outlier detection. Section 3 describes the proposed method to detect missing values and outlier. Experimental results and their analysis are presented in Section 4 and finally, Section 5 concludes the paper.

2.Literature Survey

Serial no.	TITLE	AUTHORS	YEAR	METHODS	RESULTS
1.	Computer Aided Diagnosis System for Skin Lesions Detection Using Texture Analysis Methods	Habeba Mahmoud, Mohamed Abdel-Nasser and Osama A.Omer	2018	CAD system using texture analysis method and Gabor filters, HOG, GLCM, LBP, LDN(for feature extraction)	HOG feature resulted in 97.8% AUC with common nevi & 95.4% with dysplastic nevi. LBP & LDN resulted in 87.2% & 88.3% resp
2.	Accurate segmentation and registration of skin lesion images to evaluate lesion change	Fulgencio Navarro, Marcos Escudero-Vinolo and Jesus Bescos	-	Skin lesion segmentation algorithm on the basis of a novel adaptation of superpixels technique and image registration approach	Segmentation method yields a Jaccard Index* of 0.769 & registration algorithm achieves top SOTA

3.	A Survey of Feature Extraction in Dermoscopy Image Analysis of Skin Caner	Catarina Barata, M.Emre Celebi, and Jorge S.Marques	2015	Proposed 4 different feature extraction methodologies- hand crafted, dictionary based, deep learning & clinically inspired	-
4.	A Textured Scale-based Approach to Melanocytic Skin Lesions in Dermoscopy	Rui Fonseca-Pinto,and Marlene Machado	2017	Texture based approach like Local Binary Pattern Variance(LBPV) & Bidimensional Empirical Mode Decomposition(BEMD)	97.83- Sensitivity 94.44- Specificity 96.00- Accuracy
5.	Developing a Retrieval Based Diagnostic Aid for Automated Melanoma Recognition of Dermoscopic Images	Md Mahmudur Rahman, Nuh Alpaslan, Prabir Bhattacharya	-	retrieving a number of lesions from a database of already diagnosed cases and comparing with the present case. Content-based Image Retrieval(CBIR) is used for searching and retrieving dermoscopic image	0.453- Sensitivity 0.980- Specificity 0.895- Accuracy
6.	Computational Intelligence Approaches for Malignant Melanoma Detection and Diagnosis	Munya a.Arasi, El-Sayed M. El-Horbaty, AbdelBadeeh M Salem	2017	Based on Artificial Neural Network (ANN) and Adaptive-Network-based Fuzzy Inference System (ANFIS). Also used Discrete Wavelet Transform(DWT) to extract the features from the images.	Accuracy of ANFIS-95.18% Accuracy of ANN-98.8%
7.	Classification of Benign and Malignant Melanocytic Lesions: A CAD Tool	Sameena Pathan, Lasya Lakshmi, Siddalingaswamy P C, Gopalakrishna Prabhu K	-	Effective hair detection and exclusion algorithm using bottom-hat transform and Grey Level Co-occurrence Matrix(GLCM) feature for calculating texture features.	82%- Sensitivity 85.71%- Specificity 81.25%-Accuracy
8.	Stack Auto-encoders Approach for Malignant Melanoma Diagnosis in Dermoscopy Images	Munya A.Arasi, El-Sayed M. El-Horbaty, Abdel-Badeeh M.Salem, El-Sayed A. El-Dahshan	2017	Stack Auto-Encoders(SAE) in deep learning to diagnose malignant melanoma.	Accuracy for texture analysis and SAE is 89.3% Accuracy for DWT and SAE is 94%
9.	A Clinically Oriented System for Melanoma Diagnosis Using a Color Representation	Catarina Barata, M. Emre Celebi and Jorge S. Marques	2015	Clinical information-based characterisation of images using mean colour vector in HSV colour space and usage of Correspondence-LDA algorithm for annotation	Sensitivity -78.9% Specificity -76.6% Precision - 84.9% Recall - 85.5%

10.	Improving a Bag of Words Approach for Skin Cancer Detection in Dermoscopic Images	Naser Alfred, Fouad Kheilifi and Ahmed Bouridane	2016	Bag-of-words approach for selection of patches and HOG, colour histograms and colour moments for feature extraction	SVM: Specificity – 85.6% Sensitivity – 91.2% KNN: Specificity – 91.2% Sensitivity – 88.1% AdaBoost: Specificity – 75.8% Sensitivity – 91.7% Average: Specificity – 85% Sensitivity – 91%
11.	A Low-Cost FPGA-based SVM Classifier for Melanoma Detection	Shereen Afifi, Hamid GholamHosseini, Roopak Sinha	2016	Usage of UltraFast HLS design methodology for SVM implementation on hybrid Zynq SoC	low power and hardware consumption
12.	Dermoscopic Feature Analysis for Melanoma Recognition and Prevention	Uzma Jamil, Dr. Shehzad Khalid, Dr. M. Usman Akram	2016	1. Texture feature extraction techniques: Gray Level Co-occurrence Matrices, Local Binary Patterns, Fractals, Markov Random Fields and Multi resolution autoregression 2.Shape feature extraction techniques: analysis of asymmetry of shape by Fourier Descriptors on the peripherals of the lesion.	-
13.	WN-based approach to melanoma diagnosis from dermoscopy images	Amir Reza Sadri, Sepideh Azarianpour, Maryam Zekri, Mehmet Emre Celebi, Saeid Sadri	2017	Based on fixed grid wavelet network (FGWN) for detection and usage of Dull-Razor algorithm for hair removal. D-optimality orthogonal matching pursuit (DOOMP) algorithm is used to optimise the network structure	Accuracy - 91.82%, Sensitivity - 92.61% Specificity - 91%.
14	Finding a Signature in Dermoscopy: A Color Normalization Proposal	Marlene Machado, Jorge Pereira, Miguel Silva and Rui Fonseca-Pinto	2017	Proposed colour normalization strategy based on unimodal histograms	-

3.Proposed Method

Allthe above details shows that there has been a lot of study going on in the field of skin cancer and now we propose se a novel idea for melanoma detection.In the proposal, the input for the system is the skin lesion which is suspicious to be melanoma. The images are subject to pre-processing to eject hair and noise etc.. whichcontributes in obtaining an image of very good quality. The Modified Otsu thresholding algorithm is used for image segmentation. Thevarious algorithms such as border irregularity, area, axis length etc.are used for feature classification stage and the extracted features are processed in order to classify the image as lesion, benign, suspicious or highly suspicious skin lesions. The important steps in a diagnosis of melanoma skin cancer are:

- Acquisition of lesion image.
- Preprocessing of the image to reduce noise and various irregularities.
- Segmentation of the lesion area from the outer area
- Extraction of the features from the input image.
- Classification based on the extracted features.

Feature extraction is the intent of extracting the features from the lesion image in order to characterize the melanoma.It is necessary to identify features thatare the most reproducible and diagnostically significant andformulate them into a single algorithm. But all melanomas do not have all four ABCD features. It is the combination of features (e.g., A+B, A+C, B+C, A+B+C, etc.) that render some lesions most suspicious for early melanoma. Here we present a block diagram to represent the process that is recommended in the system that we propose.The first step is the acquiring of the images by ultrasounds or any other clinical methods followed by preprocessing by which the unwanted noise like hair and glare are eliminated.Next comes the segmentation method and in this particular process the otsu method has been considered for its advantages over the other methods.

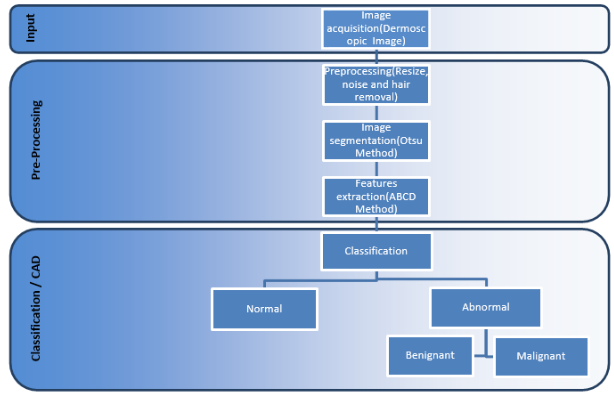

Figure 1Proposed Machine Learning Model for Melanoma CAD System

As we start the process of validation of our model, we consider 2 benign and 2 malignant images each in the following section and see their original image and preprocessed images along with their histograms:

Benign Sample Image1

Figure 2(a) Original Image
As obtained directly from database.

Figure 2(b) Image after Preprocessing
The image after applying suitable filters and removal of noise(hairs and glare).

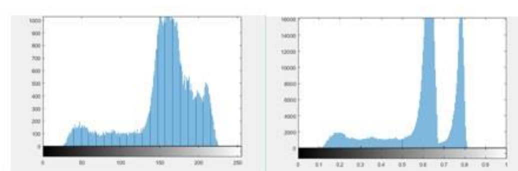

Figure 2(c) Histogram of original image

Figure 2(d) Histogram of preprocssed image

The figure 2(c) represents the histogram of figure 2(a), while figure 2(d) represents the histogram of figure 2(b).

Through the above histograms, we can clearly see the difference in the pixel density of colors between the original image and the preprocessed image.

Benign Sample Image2:

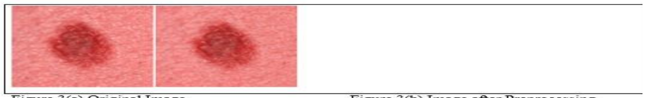

Figure 3(a) Original Image
As obtained directly from database.

Figure 3(b) Image after Preprocessing
The image after applying suitable filters and removal of noise such as hairs and glare.

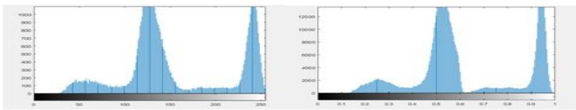

Figure 3(c) Histogram of original image

Figure 3(d) Histogram of preprocssed image

The figure 3(c) represents the histogram of figure 3(a), while figure 3(d) represents the histogram of figure 3(b).

Through the above histograms, we can clearly see the difference in the pixel density of colors between the original image and the preprocessed image.

Melanoma Sample Image1:

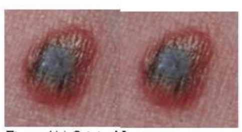

Figure 4(a) Original Image
As obtained directly from database.

Figure 4(b) Image after Preprocessing
The image after applying suitable filters and removal of noise such as hairs and glare.

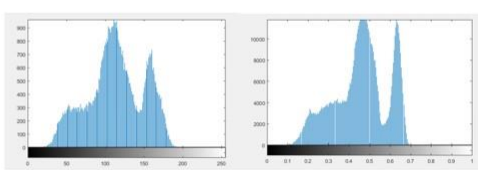

Figure 4(c) Histogram of original image

Figure 4(d) Histogram of preprocssed image

The figure 4(c) represents the histogram of figure 4(a), while figure 4(d) represents the histogram of figure4(b).

The figure 4(c) represents the histogram of figure 4(a), while figure 4(d) represents the histogram of figure4(b).

Through the above histograms, we can clearly see the difference in the pixel density of colors between the original image and the preprocessed image.

Melanoma Sample Image2:

Figure 5(a) Original Image
As obtained directly from database.

Figure 5(b) Image after Preprocessing
The image after applying suitable filters and removal of noise such as hairs and glare.

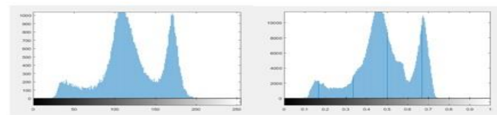

Figure 5(c) Histogram of original image

Figure 5(d) Histogram of preprocssed image

The figure 5(c) represents the histogram of figure 5(a), while figure 5(d) represents the histogram of figure 5(b).

Through the above histograms, we can clearly see the difference in the pixel density of colors between the original image and the preprocessed image.

Table 2:Number Of Training Set And Testing Set For Initial Stage Classifier

Type of image	No of training images	No of testing images
Normal	57	56
Abnormal	54	59

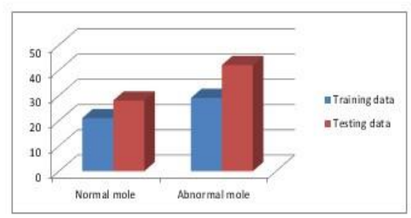

Table 3:Number Of Training Set And Testing Set For Final Stage Claassifier

Type of image	No of training set	No of testing set
Benign	46	47
Malignant	50	51

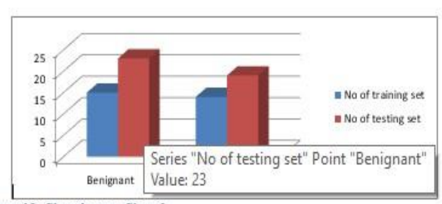

Figure10: Classification Chart 2

The above image shows the probable possibilities of a lesion as a normal, benign, suspicious lesion or highly suspicious of melanoma at different values of Area, Perimeter, Minor Axis Length and Major Axis length.

4.Conclusion

The last few decades have witnessed steady increase in the occurrence of melanoma which emphasizes the urgent need for early detection and melanoma which may lead to its cure. In the above paper, we have presented a skin cancer detection and feature extraction system which uses Modified Otsu thresholding and boundary tracing algorithm. The experimental result displays the best performance of detecting acancerous image along with identification of the stages such as benign, suspicious, highly suspicious or just a lesion. This approach gives as better results compared to the other methods used.

5.References:

1. Ruksar Fatima, Mohammed Zafar Ali Khan , A. Govardhanand Kashyap D Dhruve,”Computer Aided Multi-Parameter Extraction System to Aid Early Detection of Skin Cancer Melanoma”, IJCSNS International Journal of Computer Science and Network Security, VOL.12 No.10,October 2012,pp 74-86
2. V. Jeya Ramya, J. Navarajan, R. Prathipa& L. Ashok Kumar,” Detection Of Melanoma Skin Cancer Using Digital camera Images”, ARPN Journal of Engineering and Applied Sciences, L. 10, NO. 7, APRIL 2015,pp 3082-3085.
3. Dr. S. Mohan Kumar&Dr.T.Kumanan “Study on skin Lesion Classifications system and Dermoscopic Feature Analysis for Melanoma”, International journal of Creative Research Thoughts (IJCRT)IJCRT1802680, Volume 6, issue-1 , Page No . 1863 – 1873 , March 2018.
4. T. Saida, A. Miyazaki, S. Oguchi, Y. Ishihara, Y. Yamazaki & S. Murase . “Significance of dermoscopic patterns in detecting malignant melanoma on acral volar skin”. Arch Dermatol 140 (2004) 1233-1238.
5. S. E. Umbaugh, R.H. Moss, W.V. Stoecker, G.A. Hance,“Automatic color segmentation algorithms with applicationto skin tumor feature identification”, IEEE Eng Med BioVol. 12, 1993, pp.75-82.
6. Dr. S. Mohan Kumar&Anisha Rebinth,“Automated detection ofRetinal Defects using imagemining-A review”,European Journal of Biomedical and Pharmatical SciencesEuropean Journal of Biomedical and Pharmatical sciences ISSN : 2349 – 8870, Volume 5 , Issue : 01, 189 – 194 year : 2018.
7. Yogendra Kumar Jain, “Comparison between Different Classification Methods with Application to Skin Cancer”, International Journal of Computer Applications (0975 – 8887) Volume 53– No.11, September 2012 .
8. G. Argenziano, H.P. Soyer, S. Chimenti, R. Talamini, R. Corona, F. Sera et al. “Dermoscopy of pigmented skin lesions: results of a consensus meeting via the Internet”. J Am Acad Dermatol 48 (2003) 679-93.
9. Dr. S. Mohan Kumar&Dr.T.Kumanan “Skin Lesion Classification System and Dermoscopic Features Analysis for Melanoma recognition and Prevention”, International Journal of Emerging Technology and Advanced Engineering ,Volume 7 , Issue 8, August 2017 , Pp no: 351 – 357.
10. Nidhal K. EL Abbadi and Zahraa Faisal, Detection and Analysis of Skin Cancer from Skin Lesions, International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 19 (2017) pp. 9046-905.
11. Codella, Noel & Nguyen, Quoc-Bao &Pankanti, S & Gutman, David &Helba, Brian & Halpern, Allan & R. Smith, John. (2017). “Deep Learning Ensembles for Melanoma Recognition in Dermoscopy Images”. Ibm Journal of Research and Development 61. . 10.1147/JRD.2017.2708299.
12. Shreya R, SriLakshmiChandru,VivekKumar,ShwethaM,Dr. S. Mohan Kumar,J. Karthikayini,”Surveys on Detection ofMelanoma through imageprocessing Techniques”,International Journal for Researchin applied science and Engineering Technology,volume 6, Issue III, March 2018 inIJRASET, DOI: 10.22214), , ISSN : 2321– 9653, Impact Factor : 6.887pp. no.: 1699-1704.
13. M. S. Mabrouk, M. A. Sheha, and A. Sharawy, “Automatic detection of melanoma skin cancer using texture analysis,” International Journal of Computer Applications, vol. 42, no. 20, pp. 22–26, 2012.

14. Mariam A. Sheha, Automatic Detection of Melanoma Skin Cancer using Texture Analysis, International Journal of Computer Applications, Vol 42, No. 20, 2012.

15. Dr. S. Mohan Kumar&Dr.T.Kumanan "Analysis on skin Lesion classification systems and Dermoscopic Feature Analysis for Melanoma ",International Journal for Research in Applied Science and Engineering Technology (IJRASET)ISSN:2321-9653 ,Volume 6, Issue - 3, March – 2018 in (DOI : 10.22214),pp. no.:1971-78.

16. G. Argenziano, G. Fabbrocini, P. Carli, V. De Giorgi, E. Sammarco, andM. Delfino. "Epiluminescence microscopy for the diagnosis of doubtfulmelanocytic skin lesions. comparison of the abcd rule of dermatoscopy and a new 7-point checklist based on pattern analysis." Arch. Dermatol.,134(12):1563–1570, 1998.

17. Dr.S MohanKumar&R.Jaya,"A Survey On Medical DataMining – Health Care RelatedResearch And Challenges,International Journalof Current Research,Volume 8, Issue 01,Page Numbers;25170-25173.

18. Korotkov, K. & Garcia, R. (2012),"Computerized Analysis of Pigmented Skin Lesions: A review"" Artificial Intelligence in Medicine, Vol. 56, pp. 69-90.

19. D. Altamura, E. Altobelli, T. Micantonio, D. Piccolo, M.C. Fargnoli& K. Peris. "Dermoscopic patterns of acral melanocytic nevi and melanomas in a white population in Central Italy". Arch Dermatol 142 (2006) 1123-1128.

20. Yu, L., Chen, H., Dou, Q., Qin, J., Heng, P.A. "Automated melanoma recognition in dermoscopy images via very deep residual networks". IEEE Trans. Med. Imaging. 2017;36:994–1004.

21. EbtihalAlMansour, M. Arfan Jaffar& Shahad AlMansour "Fuzzy Contour based Automatic Segmentation of Skin Lesions in Dermoscopic Images", IJCSNS International Journal of Computer Science and Network Security, VOL.17 No.1, January 2017,pp177-186.

22. P.Jayapal ,R.Manikandan , M.Ramanan , R.S. Shiyam Sundar1 & T.S. UdhayaSuriya," Skin Lesion Classification Using Hybrid Spatial Features and Radial Basis network", International Journal of Innovative Research in Science,Engineering and Technology,pp -10014-10021.

23. Dr.MohanKumar S&Dr.Balakrishnan,"Classification Of Breast MassClassification – CAD SystemWith Performance Evaluation",International Journal Of Engineering And Computer Science,Vol 4,Issue9, September 2015.

24. Shreya R, SriLakshmi Chandru,VivekKumar,ShwethaM,Dr. S. Mohan Kumar,DrJitendranathMungara, J.Karthikayini,"Design and implementation ofCNN for detecting Melanomathrough image processing",International Journal for Researchin Applied Science and EngineeringTechnology,Volume 6, Issue - 3, March –2018 pp. No.: 2249-2253.