International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 12, December-2015

Cad System for Dermoscopy Images

Mrs. Shailaja Singh
Assistant Professor,
CSE Department, CCET Bhilai

Mr. V. P. Singh
Assistant Professor,
CSE Department, CEC Durg

Abstract **- Melanoma is one of the most dangerous skin diseases to humans, the most deadly diseases of all types of skin cancer and cancer developing from the growth in the pigment layer of the skin. Invasive melanoma alone has an estimated incidence of 76,690 and an estimated total of 9,480 deaths in the United States in 2013 [1]. Early diagnosis of malignant melanoma is a crucial issue among the experts dermatologist. Rather than clinical examination there are many new imaging technologies such as dermoscopy, infrared imaging, multispectral imaging, and confocal microscopy can serve as an adjunct to physicians and provide automated skin cancer screening. Computer Vision Diagnosis system can be very helpful in detecting and diagnosing skin pigmentation earlier and faster than typical screening programs. The proposed system is an integrated approach of Dermoscopy image enhancement and segmentation. A query image is firstly enhanced using Homomorphic filter, after then using Thresholding method skin lesion is going to be segmented from healthy skin. Further different feature extraction methods have been used to extract dermoscopy image features, e.g. shape based and texture based features.**

General Terms - Skin Cancer, Homomorphic Filter, Thresholding method, Feature Extraction

1. INTRODUCTION

Skin cancer is one of the most common and known form of cancer. It is basically caused by the uncontrolled growth of skin cells. The incidence of skin cancer is increasing by epidemic proportions. Basal cell cancer remains the most common skin neoplasm, and simple excision is generally curative. Squamous cell cancers may be preceded by actinic keratoses--premalignant lesions that are treated with cryotherapy, excision, curettage or topical 5-fluorouracil. While squamous cell carcinoma is usually easily cured with local excision, it may invade deeper structures and metastasize. Aggressive local growth and metastasis are common features of malignant melanoma, which accounts for 75 percent of all deaths associated with skin cancer. Early detection greatly improves the prognosis of patients with malignant melanoma. The incidence of both melanoma and non-melanoma skin cancer is increasing, and an accurate and timely diagnosis is important to reduce the morbidity and mortality associated with these malignancies. Each year, the American Cancer Society estimates the numbers of new cancer cases and deaths that will occur in the United States in the current year and compiles the most recent data on cancer incidence, mortality and survival. Incidence data were collected by the National Cancer Institute, the Centers for Disease Control and Prevention, and the North American Association of Central Cancer Registries and data were collected by the National Centre for Health Statistics. A Total of 1,665,540 new cancer cases and 585,720 cancer deaths are projected to occur in the United States in 2014.

Suspicious skin lesions are often biopsied, a procedure that is unpleasant for the patient and slow to yield diagnostic results. In addition, the rate of unnecessary biopsies is high [2]. Hence there is a need for a fast, accurate, and noninvasive detection method to lower the number of unnecessary biopsies as well as to minimize false negatives that are missed by dermatologists. Dermatologists need help in identifying difficult to see mass lesion cancers to decrease the number of cancers missed and to reduce the number of unnecessary biopsies of benign tissue. This paper will comprises study of Homomorphic filter applied on Dermoscopy images and then the image is undergone image segmentation using Thresholding. There are certain features unique for skin cancer regions. Such features are extracted using feature extraction technique – shape and texture. In, the future enhancement these features will be given as the input nodes to the neural network. Artificial Neural Network (ANN) will be used for classification purpose. It classifies the given data set into cancerous or non-cancerous.

2. LITERATURE REVIEW

In this section, the previous works on the main stages of a computer-aided diagnosis system are discussed. First, we review the preprocessing phase that includes the lesion segmentation task, and then consider previous work on the feature extraction.

The Dermoscopic Image in Digital format is subjected to various Digital Image Processing Techniques. Usually the image consists of noises in the form of hairs, bubbles etc. These noises cause inaccuracy in classification. The median filter is a non-linear digital filtering technique, often used to remove noise from images or other signals. Median filtering is a common step in image processing. It is particularly useful to reduce speckle noise and salt and pepper noise [4]. M. Emre Celebi et al presented in 2009 presented an effective method to enhance the contrast in dermoscopy images. They presented a method where optimal weights are determined from an RGB input image to convert it to grayscale by maximizing a histogram bimodality measure [5]. Segmentation removes the healthy

skin from the image and finds the region of interest. Usually the cancer cells remains in the image after segmentation. Thresholding often provides an easy and convenient way to perform this segmentation on the basis of the different intensities or colors in the foreground and background regions of an image. The input to a Thresholding operation is typically a grayscale or color image. After segmentation, the output is a binary image. Segmentation is accomplished by scanning the whole image pixel by pixel and labelling each pixel as object or background according to its binarized gray level [6].

This research presented by Bilqis Amaliah, Chastine Fatichah, and M. Rahmat Widyanto in 2010 used ABCD feature to calculate Total Dermatoscopic Value (TDV) for melanoma skin cancer diagnosis. Asymmetry feature consist information of asymmetry and lengthening index of the lesion. Border irregularity feature consist information of compactness index, fractal dimension, edge abruptness, and pigmentation transition from the lesion. Color homogeneity feature consist information of color homogeneity and the correlation between photometry and geometry of the lesion.

Dr. J. Abdul Jaleel, Sibi Salim, Aswin.R.B in 2012 used 2D wavelet transform for the feature extraction. In this system, 2-D wavelet packet is used and the enhanced image in gray scaled as an input. Bior 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 [6].
At this stage, the extracted from the segmented image. By extracting features, the image data is narrow down to a set of important features of image data are features which can distinguish between Malignant and Benign melanoma. The extracted features should be both representatives of samples and detailed enough to be classified. In automated diagnosis of skin lesions, feature extraction is based on the so-called ABCD-rule of dermatoscopy [5, 7]. ABCD represent the asymmetry, border structure, color variation, and dermatoscopical structure so called diameter of the lesion and define the basis for a diagnosis by a dermatologist.

3. PROPOSED METHODOLOGY

There are many problems associated with the screening of Dermoscopy images. The aim is to develop Computer aided diagnosis (CAD) systems which helps in screening Dermoscopy images for dermatologists by identifying regions with high suspicious of malignancy The ultimate goal of the proposed CAD system is to indicate such locations with great accuracy and reliability. Thus far, most studies support the fact that CAD technology has a positive impact on early skin cancer detection**.**
Methodology consists of the following phases:-

- Data Collection (Dermoscopy images)
- Study of Homomorphic filter techniques and their performance evaluation
- Segmentation using Thresholding technique
- Feature extraction (Shape based and Texture based)

3.1 Preparation of Dermoscopy Image Database

It is difficult to access real medical images for experimentation due to privacy issue. The proposed research makes use of the data collection obtained from Dermoscopy Image Database. This collection has been employed in numerous other researches intended towards automatic Dermoscopy image classification as well.

3.2 Enhancement

Early detection and diagnosis of skin cancer markedly increases survival rate. Digital Dermoscopy is believed to help skin image experts to detect skin cancer early. Accurate diagnosis also depends on the quality of the image presented to the experts. Enhancement is aimed at realizing improvement in the quality of a given image. Image enhancement can be defined as conversion of the image quality to a better and more understandable level. It concludes smoothing the input image, contrast enhancement and hair removal etc. Dermoscopy are widely used to detect skin cancer in early stages. The quality of the image may suffer from poor resolution or low contrast due to the limitations of the X-ray hardware systems. The result of enhancement shows the suspected region in a better way. And the higher value of the evaluation parameter signifies better enhancement method. Here we used Homomorphic filter for enhancement of Dermoscopy images. It basically works in frequency domain. Fig. 3.2 shows the result of preprocessing of Dermoscopy images. In this image 3.2 (a) is input image and 3.2 (b) is enhanced image.

Fig. 3.2 (a) Input Image (b) Enhanced Image

3.3 Segmentation

Segmentation aims to select and isolate (separate) objects from an overall image. Segmentation subdivides an image into its constituent regions or objects that have similar features according to a set of predefined criteria Segmentation consists of down sampling, filtering and edge detection. Down sampling stage is a process to decrease the number of pixels and eliminate some of the information from the image. With a fixed image resolution, down sampling the image size is smaller [5].
The proposed system uses thresholding technique of segmentation for segmenting the skin lesion from the background. Fig. 3.3 shows the result of segmentation in sample images.

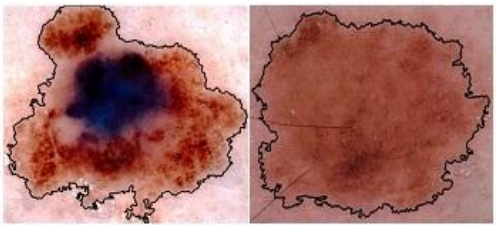

Fig. 3.3 Sample Segmentation Results

3.4 Feature Extraction

The task of the feature extraction and selection methods is to obtain the most relevant information from the original data and represent that information in a lower dimensionality space. Current image processing techniques make the small size cancer detection easier, however to classify them as cancerous and non-cancerous is still very challenging and a difficult problem for researchers. One important factor directly affects the classification result is feature extraction. In our project we extracted shape based and texture based features. It is not hard to understand that there are some features used for classification are irrelevant or redundant. The irrelevant features used for any kind of classifier not only cause the cost problem, but also affect the classification rate. In shape based features we extracted Moment Invariant and Fourier Descriptor. And in texture based feature we calculated Statistical Texture, and Haralick features.

4. RESULTS AND DISCUSSIONS

A Homomorphic filter is designed using the multiplicative and logarithmic techniques. The result of this phase is shown in Fig.4.1 for benign tumor and in Fig. 4.2 for malignant melanoma.

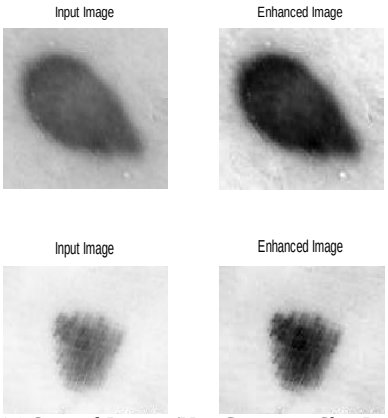

Fig 4.1 Original Images (Non Cancerous Skin Lesion) and Enhanced Images

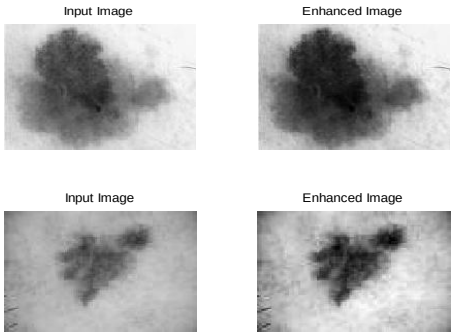

Fig 4.2 Original Images (Cancerous Skin Lesion) and Enhanced Image

In this paper, we used Thresholding technique for segmenting the skin lesion from the background. Here, initially we take the image as input that we got from the result of pre-processing stage. After then we, detected the edges of the binary image. Finally, we set a threshold value, based on that we were extracted skin lesion. The result of the segmentation phase is as shown in fig. [4.3, 4.4].

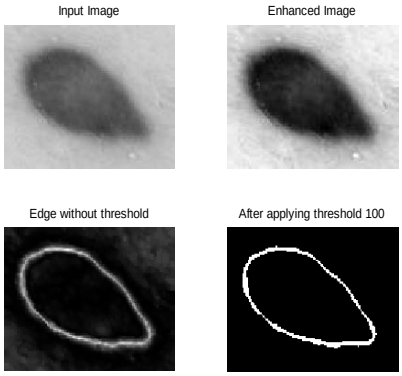

Fig. 4.3 Segmented skin lesion boundary for benign tumor

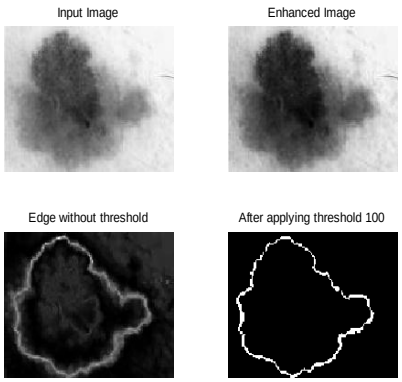

Fig. 4.4 Segmented skin lesion boundary for malignant tumor

Feature extraction is used to extract the features; similar to those visually detected by dermatologists, that accurately characterizes a melanoma lesion. In this paper we proposed a new, comprehensive and highly effective feature extraction which combines different types of features; few adopted from existing studies [9-10]. In the proposed paper different shape features (Moment Invariant and Fourier Descriptors) and texture features (Statistical Texture and Haralick Texture Features) were extracted and combined. A total of 36 features including shape and texture based features were calculated. Table 4.1 shows the values of the extracted shape based and texture based features for benign tumor existing in Dermoscopy images. And Table 4.2 shows the values of the extracted shape based and texture based features for malignant tumor existing in Dermoscopy images.

Image1	Image2	Image3	Image4	Image5
0.01	0.01	0.01	0.01	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
1.15	1.16	1.14	1.13	1.18
1.12	1.75	1.66	1.85	1.53
0.69	1.26	1.06	1.80	1.42
1.01	0.35	0.87	2.12	1.54
0.87	1.27	0.98	2.40	1.62
1.22	1.77	0.74	1.38	1.14
0.79	1.41	0.73	0.73	1.19
0.95	2.02	0.64	1.53	0.34
1.39	1.15	0.12	1.85	1.18
0.74	1.76	-0.06	2.21	0.58
6.67	12.79	5.19	18.17	55.94
45.69	55.65	46.01	55.59	45.53
0.02	0.05	0.02	0.06	0.05
6.15	7.93	4.88	4.47	4.51
0.95	0.90	0.96	0.87	0.66
0.17	0.29	0.14	0.37	0.76
0.95	0.90	0.96	0.87	0.66
1.00	1.00	1.00	1.00	1.00
0.00	0.00	0.00	0.00	0.00
0.17	0.29	0.14	0.37	0.76
1.00	1.00	1.00	1.00	1.00
23.34	25.57	22.38	26.33	25.88
6623.30	5388.59	5188.18	7209.12	4542.48
0.17	0.29	0.14	0.37	0.76
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
1.00	1.00	1.00	1.00	1.00
0.54	0.56	0.50	0.52	0.58

Table 4.1 Extracted Features for Benign Tumor Existing in Dermoscopy Images

Here in this table we can see that the extracted feature values are range to approx similar in all five columns, because all these images belong to the same category. But these values may differ from the feature values given in table 4.2.

Image1	Image2	Image3	Image4	Image5
0.04	0.04	0.05	0.05	0.04
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
1.72	1.79	1.80	1.81	1.79
1.02	0.22	1.31	0.30	0.62
1.33	1.09	0.07	0.95	1.40
0.26	0.84	0.93	1.35	0.64
0.94	0.26	1.21	1.51	0.27
0.60	1.07	0.64	2.01	0.11
0.85	1.23	1.71	1.25	1.56
0.07	1.50	1.04	1.49	1.31
0.30	1.05	1.54	0.86	1.52
1.65	0.79	0.56	1.73	1.35
10.90	27.35	17.45	11.26	29.11
105.57	108.91	104.38	107.38	108.09
0.08	0.09	0.06	0.07	0.09
24.54	25.18	24.03	20.81	19.90
0.92	0.81	0.87	0.92	0.80
0.25	0.49	0.36	0.26	0.51
0.92	0.81	0.87	0.92	0.80
1.00	1.00	1.00	1.00	1.00
0.00	0.00	0.00	0.00	0.00
0.25	0.49	0.36	0.26	0.51
1.00	1.00	1.00	1.00	1.00
106.79	104.70	104.90	105.52	108.22
40639.79	44905.72	46579.00	40976.41	46304.53
0.25	0.49	0.36	0.26	0.51
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00
1.00	1.00	1.00	1.00	1.00
0.78	0.79	0.77	0.77	0.80

Table 4.2 Extracted Features for Malignant Tumor Existing in Dermoscopy Images

5. CONCLUSION

A detailed study has been carried out related to skin cancer, its history, application of digital image processing in medical imaging. Using the concept of Digital image processing, Homomorphic Filter were applied on dermoscopy images, so that these enhanced dermoscopy images will help dermatologist to detect suspected region. After enhancing these dermoscopy images, skin lesion were segmented from the background, and then some shape and texture based feature were extracted. We studied Homomorphic filter, image enhancement technique and analyze their performance study on the suspected digital dermoscopy images. In the segmentation phase we used Thresholding technique for segmenting the skin lesion from the background. After then shape and texture feature were extracted and a feature vector were developed which contains the extracted features in MATLAB environment.

6. FUTURE WORK

In future, we will apply Artificial Neural Networks for the classification of benign and malignant melanoma. So that we would be able to classify the tumor easily that will help dermatologist for diagnosis of skin cancer.

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