MACHINE VISION TO IDENTIFY MALIGNANT MELANOMA BY ASYMMETRY ANALYSIS

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ABSTRACT: Melanoma is a cancer that begins in the melanocytes. Ultraviolet (UV) rays exposure is a major risk factor for most melanomas. In the year 2016 about 76,380 new melanomas will be diagnosed all over the world and about 10,130 people are expected to die of melanoma .Early diagnosis will not only save the life of the people but also the quality of their life. Image processing techniques play a vital role in the diagnosis of malignant melanoma. In this paper a novel method is proposed for the diagnosis of malignant melanoma using region properties like radial distance, area of normal and abnormal mole images. The results obtained show the feasibility of the proposed method for the diagnosis of malignant melanoma.

KEYWORDS: Malignant melanoma; Diagnosis; Computer vision; Region properties.

INTRODUCTION

Skin cancer is classified into two types as benign and malignant melanoma. Malignant melanoma is the deadliest form of skin cancer. Early detection melanoma can be cured completely by early detection .The dermatologists uses a device called 'Dermascope' to analysis the skin disease. Due to the examination of various patients and diagnosing each of them with careful visual interpretation is time consuming and leads to misdiagnosis. Therefore to minimize such complexities, Computer Aided Diagnostic (CAD) method was introduced which give accurate results than earlier method.

LITERATURE SURVEY

Ammara Masood.etal[1] presented the research study needed for developing an automatic diagnostic system for skin cancer detection and classification. They proposed a frame work that highlights the importance of developing benchmarks and standard approaches for model validation. Deepti Sharma.etal[2], proposed skin cancer classification system and the relationship of skin cancer image across different type of neural network.They used the Statistical region merging (SRM) algorithm to extract the affected area from the skin.Two neural networks were used as classifier namely Back-propagation neural network (BNN) and Auto-associative neural network (AANN). Dr. J. Abdul Jaleel, Sibi Salim[3], proposed the Computer based Skin cancer detection system and diagnosing methodology. The cancerous region is separated from healthy skin by the method of segmentation. Kamalpreet Kaur.etal[4], described an automatic system for inspection of pigmented skin lesions and melanoma diagnosis. They used FCM clustering and region growing for further enhancement to detect lesion area.Md.Amran Hossen Bhuiyan.etal[5],proposed an unsupervised segmentation techniques to extract the features of the segmented images. They introduced segmentation methods namely Otsu's method, Gradient Vector Flow (GVF), Color Based Image Segmentation Using K-mean Clustering. Melissa S.etal [6] focused on various CAD system techniques to perform a basic function on the dermoscopic images such as preprocessing (filtering), segmentation, feature extraction, and classification. Nilkamal S. Ramteke.etal[7],developed method for malignant melanoma detection and analysis from given photograph of patient's cancer affected area to automate the diagnosis of skin cancer. The proposed scheme used Wavelet Transformation and histogram analysis for improving the quality of an image. Rajvi Parikh.etal[8], presented the process of some clinical diagnosis methods for

detecting the type of lesion with different skin cancers.Rucha D. Thakur[9], proposed a comparative study of computer-aided diagnosis for medical image segmentation and edge detection using Neural Network & Fuzzy logic.Sonali Jadhav.etal[10],proposed with the implementation of algorithm for detection of skin cancer and infected area. They used fuzzy c means and gray level co-occurrence matrix feature extraction for identifying the skin cancer.
In this paper a novel method is proposed for the diagnosis of malignant melanoma using region properties like radial distance, area of normal and abnormal mole images. The results obtained show the feasibility of the proposed method for the diagnosis of malignant melanoma.

METHODOLOGY

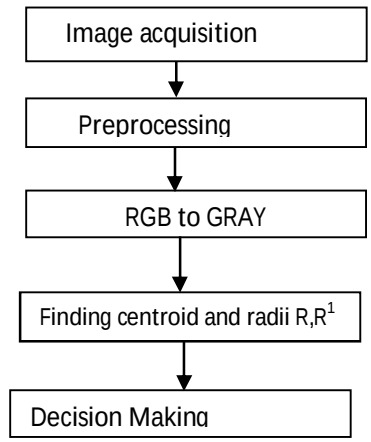

Fig 1: Block diagram for asymmetry analysis by radii R,R^1

Finding Radii $R1,R1^1,R2,R2^1$

In the proposed method, the normal and abnormal images of skin cancer are acquired .The acquired images undergo pre-processing stage namely image enhancement and Filtering by low pass filter for noise removal. After pre processing the image is converted in to grayscale and then the centroid is fixed for normal and abnormal mole images. From the centroid the radial distances $R1,R1^1$ and $R2,R2^1$ are calculated for normal and abnormal mole images respectively. Using these values Δ R1 $R1^1$ and Δ R2 $R2^1$ are found.

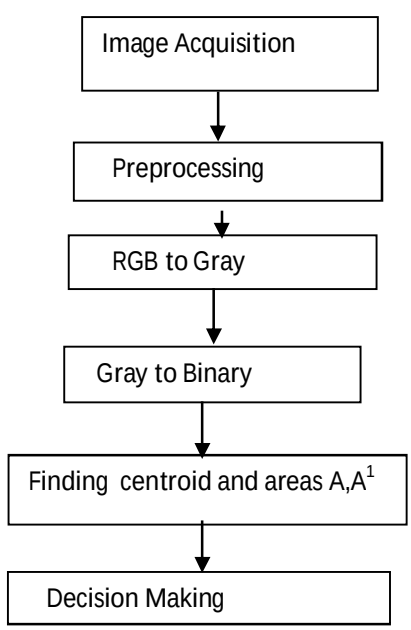

Fig 2: Block diagram for asymmetry analysis by by areas A,A^1

Finding Areas AHU,AHL and AVU,AVL

After pre processing both the normal and abnormal the images are converted in to gray which are then is converted in to binary. The centroid is fixed. About the centroid the images are divided into two halves either horizontally or vertically to form areas AHU,AHL and AVU,AVL are the upper portion area and lower portion areas of the image which is horizontally divided respectively. Here AHU,AHL are the upper portion area and lower portion areas of the image which is horizontally divided; AHU,AHL are the upper portion area and lower portion areas of the image which is vertically divided. Using these values ΔAH, ΔAV is calculated.

Decision rule

If the values Δ R1 $R1^1$ andΔ R2 $R2^1$ of the image of concern are greater than the threshold values, the image is a suspicious one, may be a malignant one. If the values are lesser than the respective threshold values, the image of interest may be a normal one. The threshold values are calculated as explained below:
The average value of Δ R1 $R1^1$ of the normal images are found and is denoted as x. The values greater than the average values are found and a data set is created of these values which is represented as X. Using the following relation ,the reference values(i.e., threshold values) are arrived at :

Reference value $R = x + \sum(X-x)/N$……[1]
Where
R= Reference value
x=average values of difference in radial distance Δ R1 $R1^1$
X=values >average values of the parameters
$=[X_1, X_2, \ldots\ldots X_n]$
N=no. of values that are > average values
Sample calculation for Δ R1 $R1^1$:

$$x = \frac{(2+2+2+5+2+1+1+2+1+1)}{10}$$

$x=1.9$

$\sum(X-x)/N$ where
$(X-x)=[X_1-x, X_2-x, \ldots\ldots X_n-x]$

$\sum(X-x)/N = \sum(X_1-x, X_2-x, + \ldots\ldots + X_n-x)/N$……[2]

$X_1=2;\ X_2=2; X_3=2; X_4=5; X_5=2; X_6=2$

$\sum(X-x)=[(2-1.9)+(2-1.9)+(2-1.9)+(5-1.9)+(2-1.9)+(2-1.9)]=3.6$

$\sum(X-x)/N=3.6/6=0.6$

$R=0.6+1.9=2.5$

Note: 1.For sample calculation the parameter Δ R1 $R1^1$ from Table-1 is considered. Table1 shows that there are six values greater than the average Δ R1 $R1^1$ value i.e., x=1.9. These values are taken as
$X_1=2;\ X_2=2;\ X_3=2;\ X_4=5;\ X_5=2; X_6=2.$
2. The same procedure is repeated for Δ R2 $R2^1$ parameter for checking the abnormality of the mole of concern.
Sample calculation for Δ AH:
The average values of Δ AH of the normal images are found and is denoted as y. The values greater than the average values are found; a data set is created of these values and is represented as Y. Using the following relation the reference values(threshold values) are arrived at :
Reference value $R = y + \sum(Y-y)/N$……[3]
Where
R1= Reference value
y=average values of pixel intensity parameters
Y=values >average values of the parameters
$=[Y_1, Y_2, \ldots\ldots Y_n]$
N=no. of values that are > average values

Sample calculation for Δ AH:

$$x=\frac{(391+200+144+210+130+144+54+422+220+199)}{10}$$

y=211.4

∑(Y-y)/N where

$(Y-y)=[Y_1-y, Y_2-y, \ldots\ldots Y_n-y]$

$\sum(Y-y)/N=\sum(Y_1-y, Y_2-y, +\ldots\ldots+Y_n-y)/N$…….[4]

$Y_1=391$; $Y_2=422$

∑(Y-y)=[(391-211.4)+(422-211.4)]=390.6

∑ (Y-y)/N=390.6/2=195.3
R1=195.3+211.4=406.7

Note:1. For sample calculation the parameter Δ AH from Table-2 is considered. Table2 shows that there are two values greater than the average Δ AH value i.e., y=211.4. These values are taken as
$Y_1=391$; $Y_2=422$
2. The same procedure is repeated for Δ AV parameter for checking the abnormality of the mole of concern.

RESULTS

Table 1: Δ R1 $R1^1$ and Δ R2 $R2^1$ of Normal and Abnormal mole images

S.NO	Images	R1	$R1^1$	Δ R1 $R1^1$	R2	$R2^1$	Δ R2 $R2^1$
1	Normal1	22	20	2	29	24	5
2	Normal2	23	25	2	29	32	3
3	Normal3	24	22	2	28	26	2
4	Normal4	21	16	5	13	14	1
5	Normal5	15	13	2	10	6	4
6	Normal6	15	14	1	19	14	5
7	Normal7	18	19	1	21	23	2
8	Normal8	32	34	2	36	39	3
9	Normal9	33	34	1	30	31	1
10	Normal10	35	36	1	31	27	4
11	Abnormal1	44	60	16	89	45	44
12	Abnormal2	38	65	27	40	26	14
13	Abnormal3	48	75	27	42	80	38
14	Abnormal4	25	66	41	70	110	40
15	Abnormal5	78	90	12	75	132	57
16	Abnormal6	43	85	42	40	57	17
17	Abnormal7	72	90	18	73	58	15
18	Abnormal8	34	52	18	53	40	13
19	Abnormal9	34	46	12	110	73	37
20	Abnormal10	50	72	22	123	100	23

Table 2: Area of Normal and Abnormal mole images

S.NO	Images	AHU	AHL	Δ AH	AVU	AVL	Δ AV
1	Normal1	6160	6551	391	6425	7286	861
2	Normal2	4122	4322	200	5610	5511	99
3	Normal3	3456	3600	144	5000	5589	589
4	Normal4	7890	8100	210	8790	8900	110
5	Normal5	2670	2800	130	3500	3760	260
6	Normal6	6890	7034	144	7896	7991	95
7	Normal7	8956	9010	54	5730	6701	971
8	Normal8	3267	3689	422	3110	3543	433
9	Normal9	6221	6441	220	7109	7404	295
10	Normal10	2210	2409	199	2309	2569	260
11	Abnormal1	7981	9622	1641	9843	8760	1083
12	Abnormal2	18939	17040	1899	13761	17090	3329
13	Abnormal3	9101	7892	1209	8932	7109	1823
14	Abnormal4	24804	21009	3795	19678	17890	1788
15	Abnormal5	12558	11234	1324	10987	9870	1117
16	Abnormal6	9605	10956	1351	9221	11764	2543
17	Abnormal7	9312	7543	1769	6345	7890	1545
18	Abnormal8	4099	5343	1244	5612	6745	1133
19	Abnormal9	7809	9765	1956	10763	12256	1493
20	Abnormal10	12335	14277	1942	13467	14890	1423

Table 3: % accuracy of proposed method

Methods	% accuracy							
	Normal mole images				Abnormal mole images			
	Δ R1 R1[1]	Δ R2 R2[1]	Δ AH	ΔAV	Δ AH	Δ AV	Δ R1R1[1]	Δ R2 R2[1]
Method-1	90	90	90	90	100	100	100	100

a

b

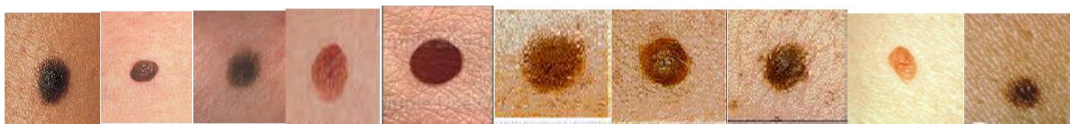

Fig 3.a)Abnormal mole images;b) Normal mole images

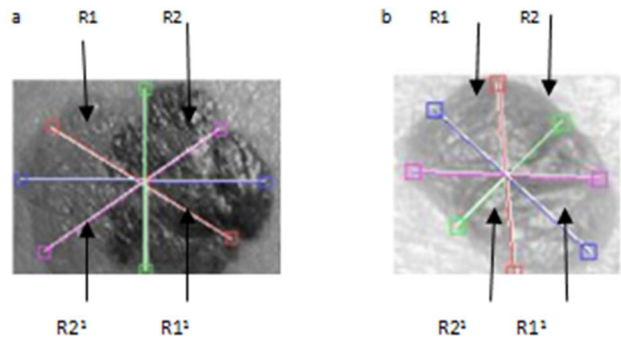

Fig 4 .a) radii R1 ,$R1^1$, R2 ,$R2^1$ ofAbnormal mole images;b) radii R1 ,$R1^1$, R2 ,$R2^1$ of Normal mole images

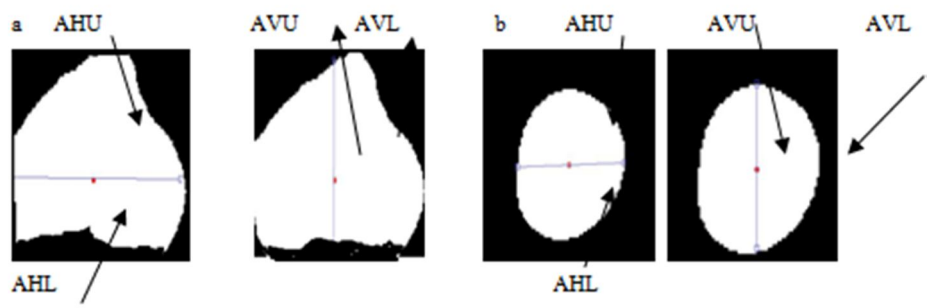

Fig 5 .a) Area AHU,AHL,AVU,AVL ofAbnormal mole images;b) Area AHU,AHL,AVU,AVLof Normal mole images

Figure-1and Figure-2 show the block diagram of the proposed method. Figure-3a. shows the Abnormal mole images whereas Figure-3b is of the normal mole images which are taken for experimentation. Figures 4a and 4b show the radii R1 ,$R1^1$, R2 ,$R2^1$ respectively. Areas AHU,AHL ,AVU,AVL are depicted in figures 5a,5b.
Table-1 shows the radii R1 ,$R1^1$, Δ R1 $R1^1$, R2 ,$R2^1$ and Δ R2 $R2^1$ of mole images. Here R1 is a radius taken from normal mole image where as $R1^1$ counter portion of the radius extended to form a diameter in the image. Similarly R2 is a radius taken from abnormal mole image where as $R2^1$ counter portion of the radius extended to form a diameter in the image. Δ R1 $R1^1$ is the difference between R1,$R1^1$ and Δ R2 $R2^1$ is the difference between R2 ,$R2^1$.Table-2 shows the values of AHU,AHL, AVH,AVL and Δ AH, ΔAV.Table-3 shows the accuracy of the proposed Method.

DISCUSSION

The proposed method is tested on a set of ten normal and abnormal mole images. The images are pre-processed and resized. Asymmetry analysis is then carried using the parameters radii and areas of these images.

Radii Analysis

For each normal and abnormal mole image the centroid is fixed and from the centroid the radii are formed. The radiiR1 and $R1^1$ are found for normal mole images. Similarly R2 ,$R2^1$ pair is made for the abnormal images.Δ R1 $R1^1$ and Δ R2 $R2^1$ are calculated. Table-1 shows that Δ R1 $R1^1$ is in the order of 1's where asΔ R2 $R2^1$ is in the order of 10's for 256*256 sized images.Δ R2 $R2^1$, the difference between R2 ,$R2^1$ of abnormal moles is found to be 10 times lesser than Δ R1 $R1^1$, the difference between R1,$R1^1$ of normal moles. This is owing to the fact that normal moles are symmetrical where as cancerous mole are asymmetrical.

Area Analysis

After converting the acquired images in to binary, both abnormal and normal mole images are divided in to two halves either horizontally or vertically and then areas are found about the centroid for the abnormal and normal mole images as shown in figure 5a,5b. From that area the difference (ΔAH) which is found from horizontal bifurcation of abnormal and normal mole images is calculated; the area difference (ΔAV) is similarly is also found for both the images but by vertical bifurcation. Table-1 shows that Δ AH, ΔA V are in 100's for normal moles and that are in 1000's for cancerous moles .The difference between the areas about the centroid is nearly 10 times more in the case of abnormal moles than in normal moles. This is also due to fact that normal moles are symmetrical where as cancerous mole are asymmetrical in

nature.The difference in values of reference and the suspicious image are found; these difference values may be taken as reference values and a reference data set may be created. The parameters of every suspicious image would be compared with the reference values and an abnormality can be suspected if these parameters are higher than the reference values.
The radial distances of these moles are obtained. The average values of the parameters namely .Δ R1 $R1^1$ and Δ R2 $R2^1$, Δ AH, ΔA V are found. Table-1 shows the parameters with average values. Using these average values the accuracy analysis of this method for diagnosis malignant melanoma is carried out by as described in the decision rule section.
In the proposed method, the average values are of Δ R1 $R1^1$ and Δ R2 $R2^1$, Δ AH, ΔA V are found are found out. An empirical relation $R= x+\sum(X-x)/N$ is proposed here to check the accuracy of this method where R is the reference value.

CONCLUSION

The proposed method is tested on twenty normal and cancerous mole images. The results obtained show that the proposed method works well to identify the cancerous moles by using the parameters namely radial distance, area which are found using the centroid of the images. The proposed method is to be tested on many more images to confirm the accuracy of this method. A scoring system may be developed to aid computer diagnosis of skin cancer by using the proposed asymmetry analysis.

ACKNOWLEDGMENT

The authors thank the Management and Principal of ACS College of engineering, Mysore road, Bangalore for permitting and supporting us to carrying out this research work.

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