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Research Article

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Extracting and Analyzing Skin Disorder's Information by Image Processing Techniques

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Abstract Different types of human skin color is a big obstacle when analyzing human skin disorders because of insufficient detecting criteria and techniques in automated extracting system, which lead to complicated detection of skin disorder via lab test, incurring a lot of delay in the process. Analyzing skin disorders on the basis of lesion color by image processing can help to minimize the time delay and cost of different medical tests. In this work, the use of Matlab to analyze human skin for extracting of skin disorder in order to ensure treatment as at when due is presented. We adopted different image processing methods, functions, and techniques to extract different disease affected skin samples for getting information. Some of these techniques were histogram analysis, morphological processing, edge detection, K-mean clustering, Watershed and polynomial curve fitting in Matlab. According to skin color detecting algorithm, we use Matlab to isolate skin disorder from human skin, extracting information of skin disorder, and analyzing skin disorder affected lesion which was done successfully. At the end of the analysis of different skin samples, several disorders were detected, which can be used by skin specialists to prescribe necessary treatments for them accordingly. Also, it is to minimize the distance between patient and doctor, and to fill up the information gap which is obstacle for fast and proper treatment. The techniques, methods and/ or algorithms used contributes knowledge to IT Professionals in applying IT skills into skin disease detection.

Keywords Histogram, Morphological processing, Noise reduction, Filtering image, and Watershed method.

Introduction

Digital image processing has changed the pattern of treatment and disease recognition for medical science with the blessing of modern information technology in computer science. Extracting information of skin disorder is our main focus for this image processing research. For this research, skin detection is needed and skin detection is necessary for human face recognition, identification and tracking. The meaning of skin detection is the existence pixels of a skin sample image will be classified in skin and non-skin classes. In this way, so many researches have done until now. In most of the proposed methods, researchers have tried to define and extract a feature vector for each pixel of image and in the end, classify the feature vectors. In most methods, color space has been used to extract the features. For instance, in RGB space [1], in HSV space [2] and in YCbCr space [3] have been used. Also other color spaces like HSI, UCS have been used in some of the approaches. In some methods, also the texture analysis [2] and Mixture of Gaussians [4] have been used to extract the more meaningful and necessary features. There are some major dictates that all researchers try to revolve and analyze them in human skin detection criteria. There are so many types of human skin disorders which are very dangerous and harmful for life according to medical science. Most of them are situational or genetic and temporary or permanent, and may be painless or painful. In this research, we are going to extract the information of skin disorder by digital image processing. In materials and methods section, we will discuss about different image processing techniques to analyze and extract human skin disorder by applying different algorithms, functions and methods.

Materials and Methods

This research working procedure is divided into two sections. Firstly we are going to analyze human skin color by histogram image processing techniques for making a clear differentiated image which will show us difference between skin disorder affected skin and good skin. Secondly we are going to extract and analyze skin disorder affected lesion. For the sake of this research the following summary found in Figure 1is referenced to provide context to the steps in a typical computer vision application.

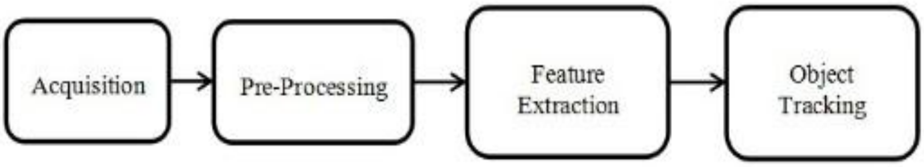

Figure 1: Procedure technique

I. Analyzing Skin Color

For isolating skin disorder from human skin, should apply histogram processing. The range of data by splitting constructs histogram into equal-sized classes and for each class, the total number of points from the data set that falls into each class are counted [5]. Figure 2 shows us different types of human skin texture, Figure 3 for grayscale image and Figure 4 for histogram process, while Figure 5 represents histogram process with adjust function of different types of skin texture according to Figure 2.

Figure 2: Different human skin texture

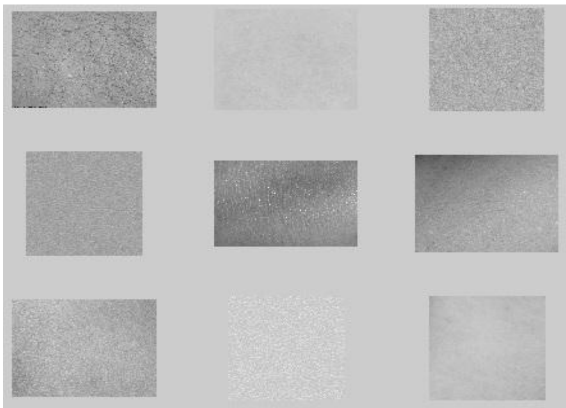

Figure 3: Grayscale Image

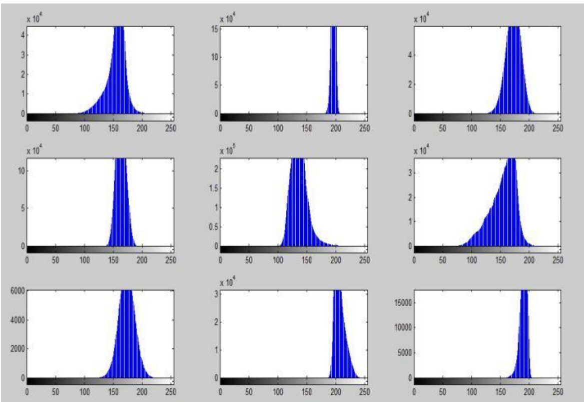

Figure 4: Histogram Image

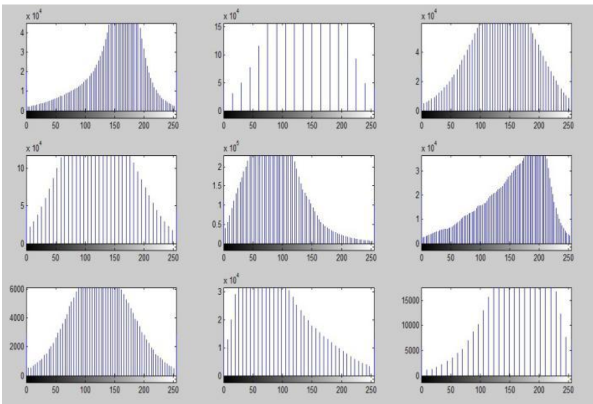

Figure 5: Adjust histogram function Image

Figure 6: Different human skin disorder

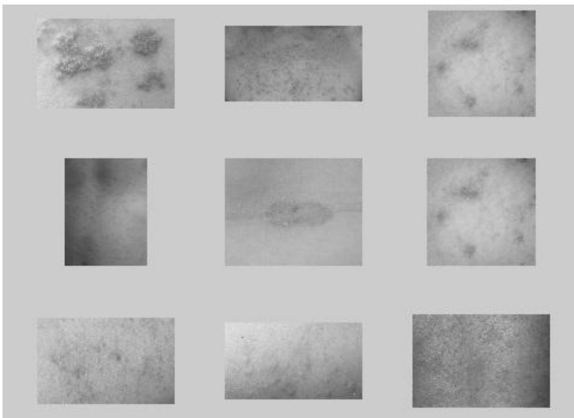

Figure 7: Grayscale Image

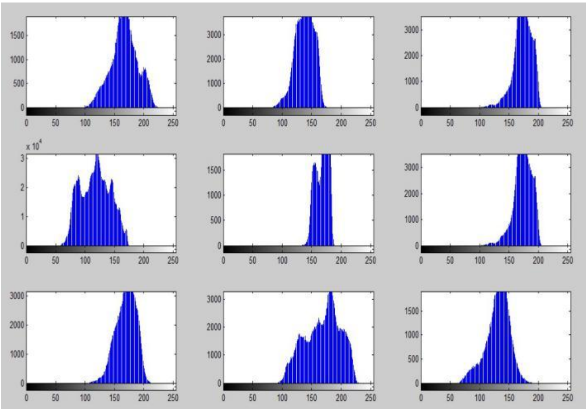

Figure 8: Histogram Image

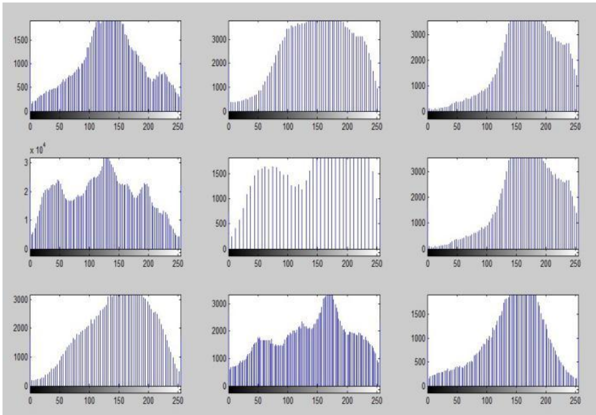

Figure 9: Adjust histogram function Image

II. Analyzing Skin Disorder

Getting information from an image is a complicated process because of input image pattern and pre-processing image techniques. To extract information and to analyze input image according to expecting output, should follow different specific techniques. Here we are going to discuss about some image processing techniques according to skin color algorithm.

A. Histogram Image Processing

The image histogram is a type of histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. By looking at the histogram for a specific image a viewer will be able to judge the entire tonal distribution at a glance [6]. Histogram is a graphical represent of pixel intensity values. It has two axis which are X and Y. In X axis, it shows 256 levels of intensity value of an image which is started from 0 to 255 for 8 bit per pixel [7]. Besides, in Y axis, it counts the intensities. To present pixel intensity values of RGB channels, either 2D histogram is required for each channel or all channels can be represented by 3D histogram with 3 axis [8]. Figure 10 shows the original input image while Figure 11 and 12 show the histogram and level .65 histogram image.

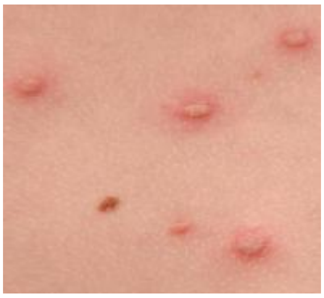

Figure 10: Input

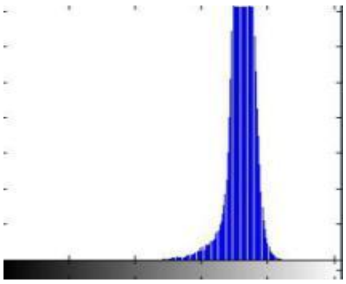

Figure 11: Histogram

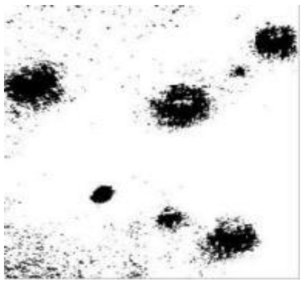

Figure 12: Level .65

B. Edge Detection

Edge detection includes a variety of mathematical methods that aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities [9]. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. The same problem of finding discontinuities in 1D signals is known as step detection and the problem of finding signal discontinuities over time is known as change detection [10]. Edge detection is an essential method which is needed for proper image segmentation and it can transform input image into edge image where shows the change of gray tone in the output image. For getting information about lesion boundary and density of blisters should follow edge detection functions.There are four types of edge detection functions in image processing which are Sobel, Prewitt, Robert, Log, Canny, and Zerocross [11]. Figure 13 to 18, show us after applying different edge detection functions in our input sample skin disorder image. After applying this formula, the depth of lesion, discontinuities in surface orientation, changing and variation of lesions, and disease affected area's total amount are clearly visible for understanding.

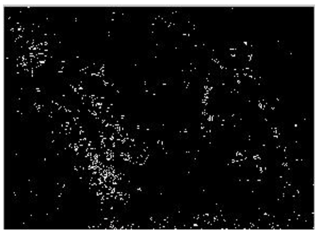

Figure 13: Sobel

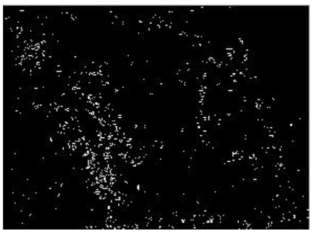

Figure 14: Prewitt

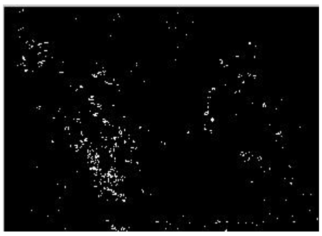

Figure 15: Robert

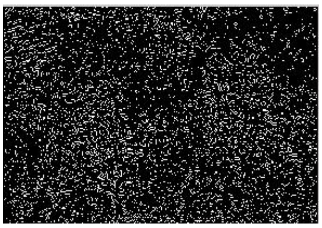

Figure 16: Log

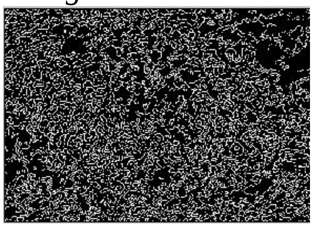

Figure 17: Canny

Figure 18: Zerocross

C. Reducing Noise and Filtering Image

Basically, each pixel of an image is changed from its input format value with a small amount in Gaussian noise reducing method [13]. The histogram, a plot of the amount of distortion of a pixel value against the frequency with which it occurs, shows a normal distribution of noise. While other distributions are possible, the Gaussian normal distribution is usually a standered model, due to the central limit theorem that says that the sum of

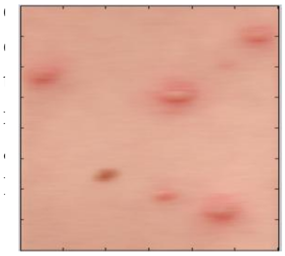

Figure 19: Blurred Image

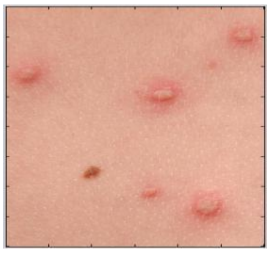

Figure 20: Recovered Image

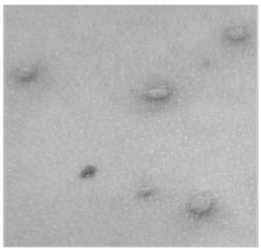

Figure 21: Before Wiener

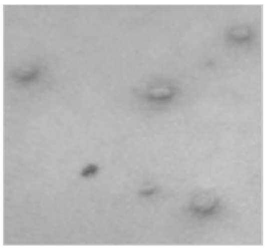

Figure 22: After Wiener

For Figure 19: Blurred input image.
For Figure 20: paf=fspecial('motion',len,theta);
recover=deconvwnr(blurred,paf,0);
For Figure 21: a=rgb2gray(imread('Input.jpg'));
For Figure 22: b = wiener2(a,[5 5]);

Figure 23: Original

Figure 24: Salt-paper

Figure 25: Median

For Figure 23: Original input grayscale image.
For Figure 24: N=imnoise(i,'salt & pepper',0.02);
For Figure 25: K=medfilt2(N);
For Figure 26: Original input grayscale image.
For Figure 27: h=[-1,-1,-1;-1,-1,-1;-1,-1,-1]/-9; c=imfilter(Input,h);

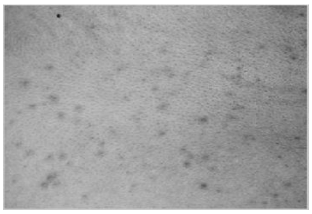

Figure 26: Original Image

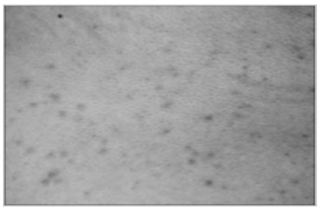

Figure 27: Average Filter

D. Watershed

The transformation of watershed can make effective good results when its combined with a fast algorithm basis on the topological gradient approach. Watershed algorithm has some different types of technical assignments [14]. In the graph, either nodes or edges are delimited by watershed lines, but both nodes and edges are delimited together by hybrid watershed lines. For computing watershed process, there are also some different methods and techniques which can be defined in continuous domain. Basically initial stage image segmentation is the main purpose of watershed process. Here we are going to apply watershed algorithm to get our output. For image segmentation various techniqueshave used in the concept of watershed algorithm.

For Figure 28: I=rgb2gray(A); [A is skin allergy sample]
For Figure 29: I1= imtophat(I,strel('disk',10));
For Figure 30: I2=imadjust(I1);
For Figure 31: lvl=graythresh(I2); bw=im2bw(I2,lvl);
For Figure 32: C=~bw;
For Figure 33: d=-bwdist(C); d(C)=-Inf; l=watershed(d);
For Figure 34: Wi=label2rgb(l,'hot','w');
For Figure 35: im=I; im(l==0)=0;

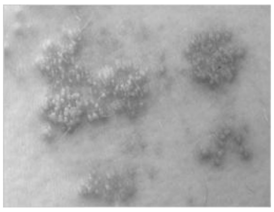

Figure 28: Gray-scale of Input

Figure 29: Tophat function

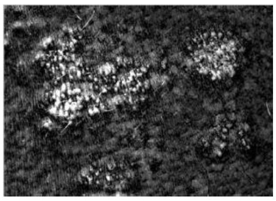

Figure 30: Adjust Image

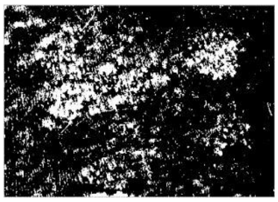

Figure 31: Graythreshold b/w

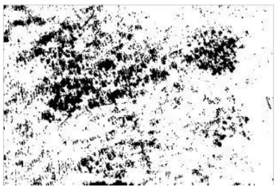

Figure 32: Reverse b/w

Figure 33: Water-shad

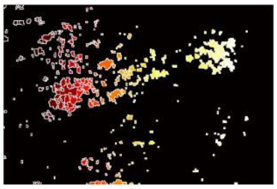

Figure 34: Hot level

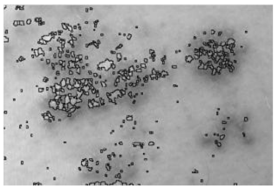

Figure 35: l==0 output of

Basically from the binary morphology image, it is possible to extend to grayscale morphology image. The sample input image is transformed into a gradient image and it represents the strength of each edge's pixel. Binary image sometimes is not perfect, that imperfection image contains information what is needed to extend [15]. Morphological operation has done on the basis of threshold. Erosion, Dilation, Opening and Closing are the part of morphological operation. Figure 36 is the original image while Figure 37 is the reverse image. In Figure 38 to 41, are shown respectively erosion, dilation, closing and opening.

Figure 36: Original

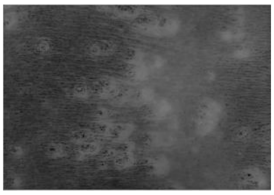

Figure 37: Reverse

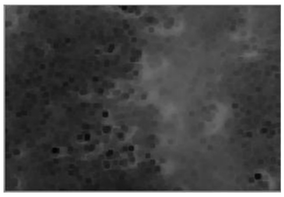

Figure 38: Erosion

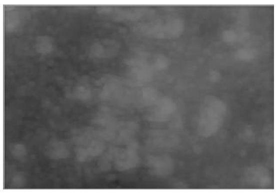

Figure 39: Dilation

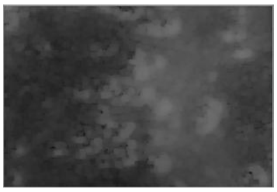

Figure 40: Opening

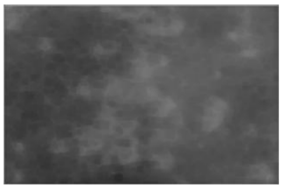

Figure 41: Closing

F. Color Analyzing

Color analyzing of lesion is important cause it represents the type of allergy. According to color range, colors are classified here like black, red, yellow, and white. In Figure 43, 44, and 45; the number of red, white and yellow spots have shown while Figure 42 is the input lesion image. Here the range of colors are -

red=handles.aa(: , : , 1);
green=handles.aa(: , : , 2);
blue=handles.aa(: , : , 3);
for red: out= 250>red>210 & 160>green>90& 145>blue>50;
for black: out= 120>red>64 & 100>green>60 & 90>blue>60;
for yellow: out= 235>red>220&150>green>130& 125>blue>90;

Figure 42: Input lesion image

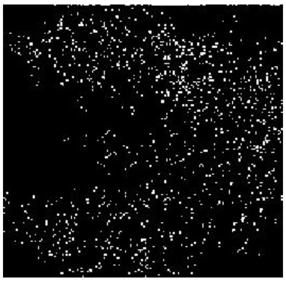

Figure 43: Red color in lesion

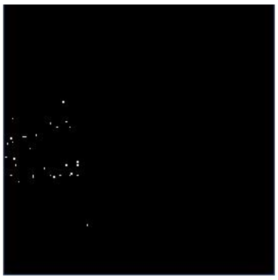

Figure 44: Black color in lesion

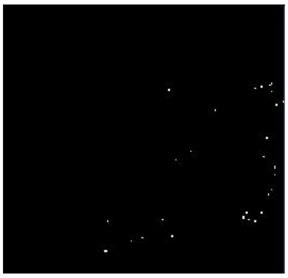

Figure 45: Yellow color in lesion

G. Segmentation by Polynomial Curve Fitting

Threshold analyzing helps to get idea about density changing of pixel according to grayscale. The inputs or sample images are segmented by a polynomial fitting curve to get the histogram and also to find the point of infliction where can fix the minimum range to do thresholding process [16]. Polynomial curve fitting methods are going to analyze threshold value of input image which is Figure 46, while Figure 47 is the histogram.

For Figure 48: im2bw(I,0.6);

For Figure 49: [counts,X]= imhist(I);

```
P=polyfit(X,counts,6); Y=polyval(P,X);
[V,ind]=sort(abs(diff(Y)));
secondd=diff(V);
```

```
        [valuem,i]=min(secondd);
        thresh=ind(i)/255;I
        m2bw(I,thresh);
For Figure 50: level=graythresh(I); im2bw(I,level);
For Figure 51: figure,plot(X,counts);
        hold on; plot(X,Y,'r');
```

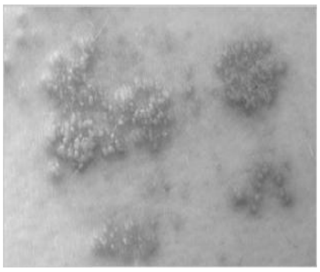

Figure 46: Input image

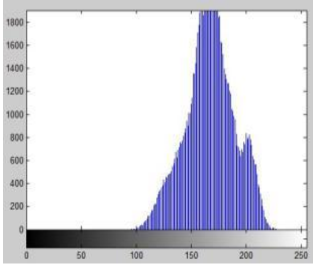

Figure 47: Histogram image

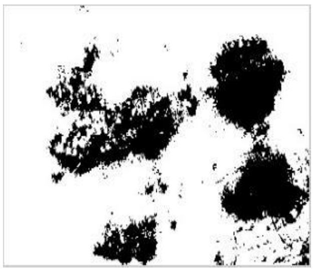

Figure 48: Black and white 0.6

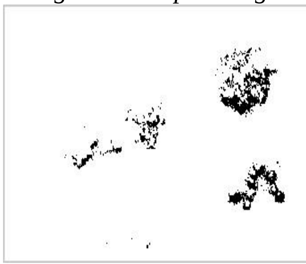

Figure 49: B/W threshold

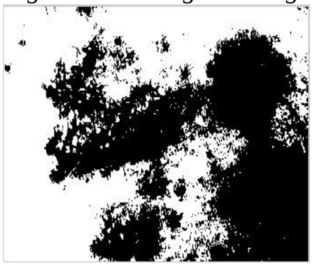

Figure 50: B/W level

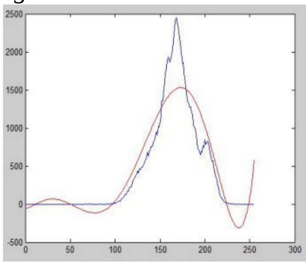

Figure 51: Polynomial Curve

Output and Result Analysis

In this research, all outputs of different image processing functions are equally important to make decision. After making separation between good and affected skin according to skin color algorithm, it is specified the analyzing portion of skin disorder to apply different image processing techniques. So that after applying image processing functions and algorithms, the system shows us- difference between good skin and lesion, lesion color and percentage, the shape of fluid filled blisters, and total amount of lesion by the number of pixel. Maintaining a certain distance to captured image from patient’s body as input is the compulsory part of image acquisition techniques. To fix the ratio, we have always maintained this rules. By applying this formula, we have collected samples. Figure 52 shows us some skin color of different people and Figure 53 shows us some lesions of different patients.

Detecting lesion is our main focus for this research for extracting information of skin disorder. From sample input images, by applying different image processing techniques, formulas and algorithms have to analyze lesion. So that binary image processing, threshold analyze, filtering, K means clustering and morphological operations are required to get the output. Sometimes also need to do image compression and decompression process according to image size and pixel ratio. Figure 54 shows us the detecting lesions of different input samples.

Figure 52: Skin color of different people

Figure 53: Different images of lesion

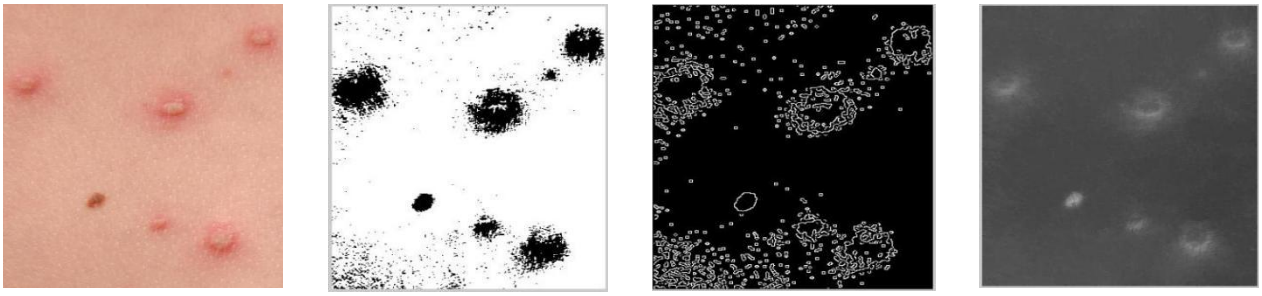

Figure 54: Detecting lesions of different input samples

Lesion color can change the whole skin disorder type, symptoms and also treatment pattern. After detecting lesion, should analyze the color of lesion. In this case we need to do main the color range for black, yellow, red color. When lesion color range will be the same with the given range color which is fixed by the system, then automatically it shows us the total spot number for the corresponding color like black, yellow and red. Again if we want to see other colors of lesion that time we need to change the range of color. In this way we can see the total different color spots in the lesion. Now we can arrange our working steps for this analyzing process like - fixing the color range for our expectation color, matching with the lesion color spot, and counting the lesion color spot which is matched with fixed color range. Figure 55 shows us the total color spots for black, yellow and red color in different lesions where inputs are different.

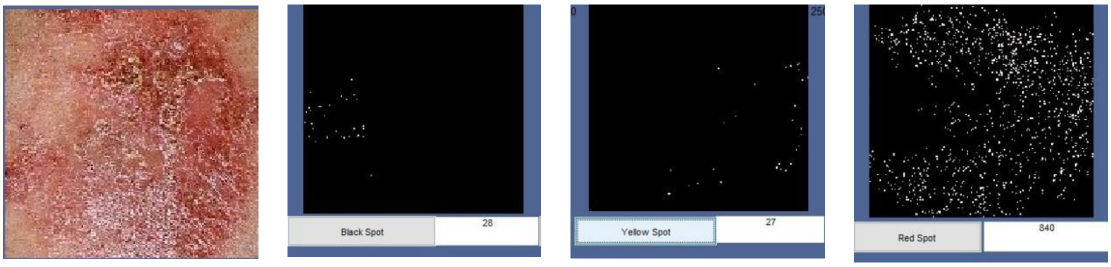

Figure 55: Detecting Black, Yellow and Red spot in lesion

After finishing detecting lesion and analyzing lesion color, should analyzing fluid filled blisters for getting more accurate result according to our expectation. In this process we have applied different image transformation methods, watershed image segmentation techniques to highlight fluid filled blisters in different way for better understanding the condition of lesions. Intuitively, the watershed of a relief correspond to the limits of the adjacent catchment basins of the drops of water. Watershed by flooding, watershed by topographic distances, watershed by the drop of water principle and inter pixel watershed methods are popular for image segmentation. Here we have tried to use some of these watershed techniques with others basic image processing techniques like binary, grayscale, threshold, RGB and hot color-map processing. We can see the output of analyzing fluid filled blisters for different input images of lesions in Figure 56.

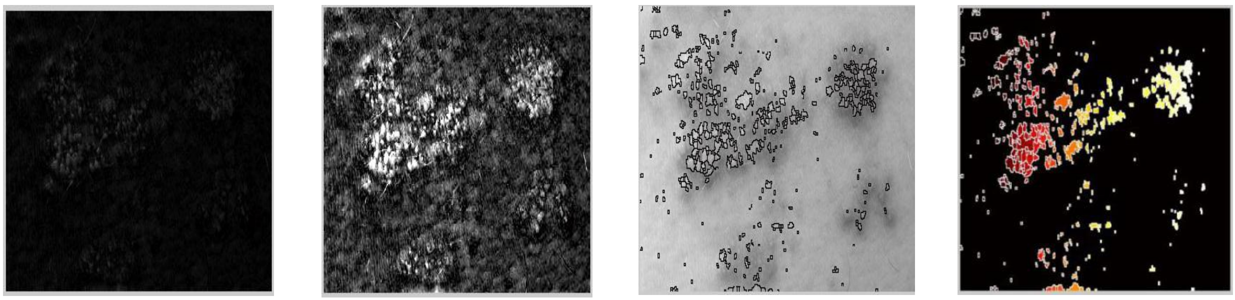

Figure 56: Analyzing fluid filled blisters in lesion

After completing all steps of digital image segmentation, counting the total pixel number of lesion is our final step. We should count the total pixel number of lesion because it helps to get an idea about the amount of lesion area which is very useful to realize the skin condition and type of skin disorder. This process is nothing but combination of other image processing functions which are already discussed in our previous image segmentation sections. According to different color spot, total number of fluid filled blisters and position of lesion, the total area of lesion will be measured by the systems. In Figure 57, we can see different input lesion images and after completing image segmentation process, the total pixel numbers of lesions are visible as output.

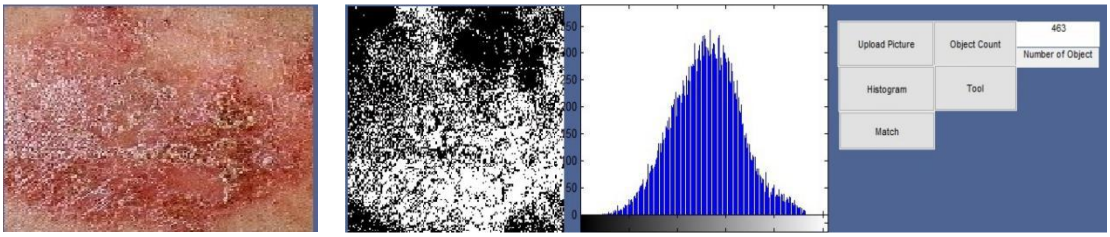

Figure 57: Counting total pixel of lesions for different input

These information help to understand the condition and to take the decision about skin disorder. Sometimes it is hard to make difference between good skin and lesion because of other things on skin like scar, birthmark and tattoo, so should avoid these things. Lesion color and percentage represent disorder type, on the other hand the shape of fluid filled blisters tells the stage of skin disorder. Amount of lesion according to pixel number helps to get idea about seriousness of disease.

Conclusion

In this research, we have tried to established some methods to solve analyzing problem of skin disorder according to skin color detecting algorithm. Sample images of patient's good skin of nearest disease affected area and lesions are the inputs for this system. Image acquisition process is the most important part of it, because focus distance and pixel ratio can change the whole outputs and results. Different algorithms of image processing help to get idea about the criteria of skin disorder analysis which can help to make a decision for automation system. This research primarily contributes to medical profession in dealing with skin disorder matters, by minimizing the normal delayed diagnosing methods of skin laboratory testing. This would contribute knowledge to skin specialist in using this technique to acquire information of skin disorder cases. Also, the use of various algorithmic techniques in Matlab connotes the contribution of this work to the application of IT, adding relevance to IT products.

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References

[1]. Kakumanu, P., Makrogiannis, S., & Bourbakis, N., 2007,"A survey of skin-color modeling and detection methods", Pattern Recognition, Vol. 40, pp. 1106 – 1122.

[2]. Jones, M.J., & Rehg, J.M., 2002, "Statistical color models with application to skin detection", International Journal of Computer Vision, Vol. 46, No. 1, pp. 81-96.

[3]. Hsu, R.L., Mottaleb, M.A., & Jain, A.K., 2002, "Face detection in color images", IEEE Trans. Pattern Analysis and Machine Intelligence, Vol. 24, No. 5, pp.696–706.

[4]. Yang, M.H., & Ahuja, N., 1998, "Detecting human faces in color images", In Proc. IEEE International Conf. on Image Processing, Chicago, Illinois, USA, pp. 127-130.

[5]. Devi H.K.A., December 2006, "Thresholding: A Pixel-Level Image Processing Methodology Preprocessing Technique for an OCR System for the Brahmi Script", Ancient Asia. 1, pp.161–165.

[6]. Jean-Christophe Terrillon and Shigeru Akamatsu, 1999, "Comparative Performance of Different Chrominance Spaces for Color Segmentation and Detection of Human Faces in Complex Scene Images", Vision Interface 1999, Trois-Rivières, Canada, 19-21 May.

[7]. Daniel P., and Neelima G., January 2012, "Image Segmentation by using Histogram Thresholding", International Journal of Computer Science & Engineering Technology, vol 2, no. 1, pp: 776-779.
[8]. Khurana K., Awasthi R, 2013, "Techniques for Object Recognition in Images and Multi-Object Detection". International Journal of Advanced Research in Computer Engineering & Technology, Vol. 2 (4), pp: 1383 – 1388.
[9]. Muthukrishnan. R, and M. Radha, December 2011, "Edge Detection Techniques for Image Segmentation", International Journal of Computer Science & Information Technology (IJCSIT) vol. 3, no. 6, pp: 259-267.
[10]. Lakshmi H, Patil S, 2010, "Segmentation Algorithm for Multiple Face Detection in Color Images with Skin Tone Regions using Color Spaces and Edge Detection Techniques". International Journal of Computer Theory and Engineering, Vol. 2 (4), pp: 0552-0558.
[11]. Ramakrishna G, Swain D, 2014, "An Adaptive Edge Detection for Mycosis Fungoides Skin Disease". International Journal of Computer Applications, Vol. 94 (2), pp: 021 – 026.
[12]. Rafael C. Gonzalez and Richard E. Woods, 2004, "Digital image processing", 2nd edition, Addison-Wesely.
[13]. Mythili C., and V. Kavitha, 2011, "Efficient Technique for Color Image Noise Reduction", The Research Bulletin of Jordan ACM - ISWSA, vol. 2(3), pp: 41- 44.
[14]. Belaid L. J. and W. Mourou, 2009, "Image Segmentation: A watershed transformation algorithm", Image Anal Stereol 2009; vol.28, pp: 93-102.
[15]. Parvati K., B. S. Prakasa Rao, and M. Mariya Das, 2008, "Image Segmentation Using Gray-Scale Morphology and Marker-Controlled Watershed Transformation", Hindawi Publishing Corporation Discrete Dynamics in Nature and Society, Article ID 384346, pp:1-8.
[16]. Zhang Y. and J. Gerbrands, 1991, "Transition region determination based thresholding", Pattern Recognition Letters, vol. 12, pp. 13-23.