Extraction of connected components Skin pemphigus diseases image edge detection by Morphological operations

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ABSTRACT
In the present paper, a Skin pemphigus diseases image detection method color based segmentation and morphological operation is proposed. Three Stages proposed: First stage: the color based segmentation takes in only one color spaces HSV, instead of three color spaces, Second stage the morphological operations with their analysis While third stage contain Extraction of connected components Skin image edge detection and a template matching. For each stage a novel algorithm which combines pixel and region based color segmentation techniques is used. Algorithm for skin segmentation of color image sequences. The experimental results for Skin pemphigus diseases image detector confirm the effectiveness of the proposed algorithm.

General Terms
Pattern recognition; pattern matching, Digital Image Processing, Algorithms.

Keywords
Skin image detection, Image Color, Morphology Operations, HSV color space, connected components, Opening, Dilation, Template matching.

1. INTRODUCTION
Detection of edge is a critical element in image processing, since edges contain a major function of image information [1]. It is a fundamental tool, which is commonly used in many image processing applications to obtain information from images and frames. The separation of the image into object and background is a critical step in image interpretation. An edge may be regarded as boundary between two dissimilar regions in an image. Edge detection is a terminology in image processing and computer vision, particularly in areas of feature detection and feature extraction [2].

Mathematical morphology is a theory of image transformations and image functional. Morphological operations are based on simple expanding and shrinking operations. Mathematical morphology examines the geometrical structure of an image by probing it with small patterns, called 'structuring element', of varying sizes and shapes. This procedure results in non-linear image operators which are well suited to exploring geometrical and topological structures [3].

Mathematical morphology is theoretically founded on set theory [4]. It contributes a wide range of operators to image processing, based on a few simple mathematical concepts. The operators are particularly useful for the analysis of binary images, boundary detection, noise removal, image enhancement, and image segmentation. The advantages of morphological approaches over linear approaches are [4]:

1) Direct geometric interpretation,

2) Simplicity

3) Efficiency in hardware implementation.

Mathematical morphology is a well-founded non-linear theory of image processing. Its geometry-oriented nature provides an efficient framework for analyzing object shape characteristics such as size and connectivity, which are not easily accessed by linear approaches, the hardware complexity of implementing morphological operations depends on the size of the structuring elements [4].

Mathematical morphology examines the geometrical structure of an image by probing it with small patterns ,called 'structuring element', of varying sizes and shapes .This procedure results in non-linear image operators which are well suited to exploring geometrical and topological structures. They do provide the strong visual clues that can help the recognition process [5].

One of the most important applications is edge detection for image segmentation. The process of partitioning a digital image into multiple regions or sets of pixels is called image segmentation. Edge is a boundary between two homogeneous regions. Edge detection refers to the process of identifying and locating sharp discontinuities in an image [6].

In our research we will use the Mathematical morphology method to edge detection for the Skin pemphigus diseases images because this method will provide the strong visual clues that can help the recognition process and this not allow in the other methods for edge detection.

The paper is organized as follows; Section 2: contain the discussion for many techniques used for age detection and why we chose the proposed method in our research. Section 3: deals with the Skin Color Segmentation are to reject non-skin color regions from the input. Section 4: deals with the Morphology Operations i.e. opening to perform the connected component analysis, section 5: Connected Region Analysis, section 6: deals with the design of template and its matching. Section 7: gives the overview of algorithm with results and last section 8: ends the paper with conclusion.

2. RELATED WORK

In the recent years there are many techniques used for edge detection such as [3]:

1. Sobel operator
2. Canny edge detection
3. Prewitt operator
4. Laplician of Gaussian
5. Roberts edge detection

Sobel operator is used in image processing techniques particularly in edge detection. The sobel operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical and is therefore relatively inexpensive in terms of computations.

Canny edge detection operator was developed by John F. Canny in 1986 and uses a multistage algorithm to detect a wide range of edges in images.

Prewitt operator edge detection masks are the one of the oldest and best understood methods of detecting edges in images. Basically, there are two masks, one for detecting image derivatives in X and one for detecting image derivative in Y. To find edges, a user convolves an image with both masks, producing two derivative images (dx and dy). The strength of the edge at given location is then the square root of the sum of the squares of these two derivatives.

Roberts's edge detection method is one of the oldest methods and is used frequently in hardware implementations where simplicity and speed are dominant factors.

In our research we will use the Mathematical morphology method to edge detection for the Skin pemphigus diseases images because this method it is examines the geometrical structure of an image by probing it with small patterns, called 'structuring element', of varying sizes and shapes .This procedure results in non-linear image operators which are well suited to exploring geometrical and topological structures. They do provide the strong visual clues that can help the recognition process and this not allow in the other methods for edge detection.

3. SKIN COLOR SEGMENTATION

The goal of skin color segmentation is to reject non-skin color regions from the input image [7]. So, the Skin diseases pemphigus detector consists of a set of weak classifiers that sequentially reject non-Skin regions. First, the non-skin color regions are rejected using color segmentation. A set of morphological operations are then applied to filter the clutter resulting from the previous step. The remaining connected regions are then classified based on their geometry and the number of holes. Finally, template matching is used to detect the Skin regions that have pemphigus diseases in each connected region. A block diagram of the detector is shown in "Figure 1"[7].

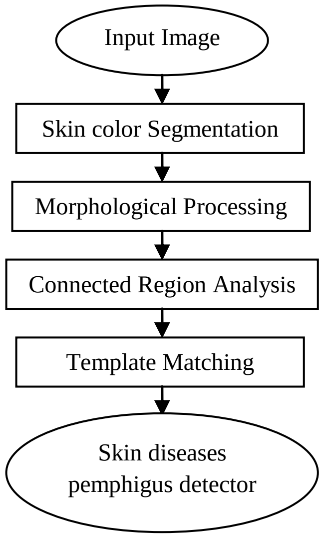
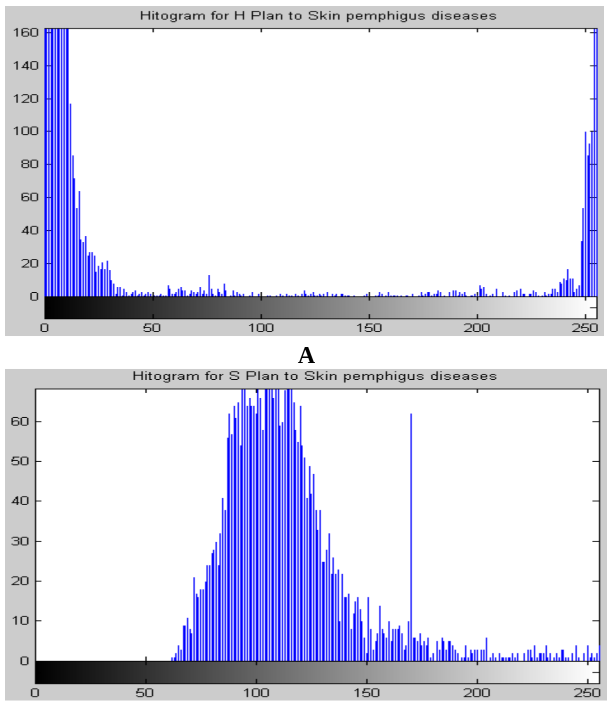


Fig. 1: Block diagram of Skin diseases pemphigus detector

We chose the HSV (Hue, Saturation, and Value) color space for segmentation since it decouples the chrominance information from the luminance information. Thus we can only focus on the hue and the saturation component. The Skin pemphigus diseases in each training image were extracted using the ground truth data and a histogram was plotted for their H and S color component "Figure 2".



B

Fig. 2: Histograms for the H and S components of Skin Pemphigus diseases image

During the execution of the detector, segmentation is performed as follows [7]:

1. The input image is subsample at 2:1 to improve computational efficiency.
2. The resulting image is converted to HSV color space.
3. All pixels that fall outside the H and S thresholds are rejected (marked black).

The result after applying these steps is shown in "Figure 3".

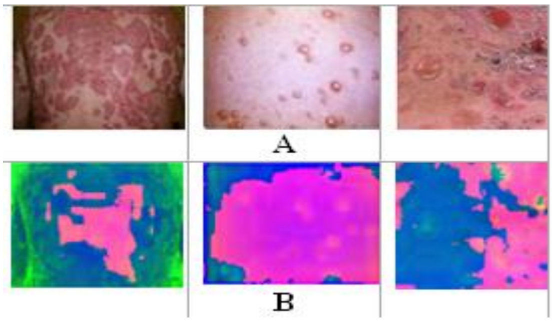


Fig. 3: Images after histogram thresholding **(A) original image, (B) HSV image**

The histograms reveal that the H and S color components for Skin pemphigus diseases are nicely clustered. "Figure 4" show the original skin pemphigus diseases, H plane, and S plane and V plane. This information was used to define appropriate thresholds for H and S space that correspond to the connected Skin pemphigus diseases. The threshold values were embedded into the color segmentation routine.

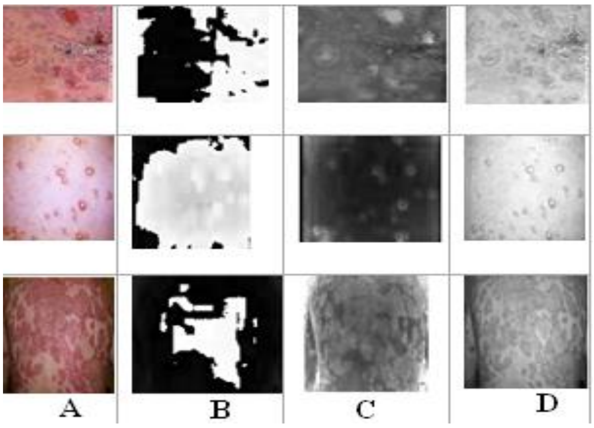


Fig. 4: (A) original image, (B) H plane, (C) S plane and (D) V plane

The"intensity","lightness" or"value" is related to the color luminance. An alternative way of hue and a different representation of Hue-Saturation using Cartesian coordinates can be used:

$$X = S\cos H, \; Y = S\sin H \qquad (1)$$

The HSV color space, however, is much more intuitive and provides color information in a manner more in line how humans think of colors and how artists typically mix colors [8].

4. MORPHOLOGY OPERATIONS

Mathematical Morphology is one of the most productive areas in image processing. The content of mathematical morphology is based on set theory. A structuring element is a special mask filter that enhances input images .It can be of different sizes and of different shapes (square, diamond, and circle).
Following are the main mathematical morphological operators [14]:

1. Dilation
2. Erosion
3. Opening
4. Closing

Figure 3 shows that skin color segmentation did a good job of rejecting non-skin colors from the input image. However, the resulting image has quite a bit of noise and clutter. A series of morphological operations are performed to clean up the image, as shown in "Figure 5"[7]. The goal is to end up with a mask image that can be applied to the input image to yield skin color regions without noise and clutter [7].

Structuring element is a characteristic of certain structure and features to measure the shape of an image and is used to carry out other image processing operations [1].

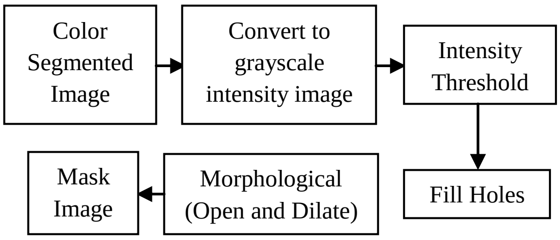


Fig 5: Morphological Processing on the color segmented image

The first step convert original image to Gray image See "Figure 6", Intensity threshold is performed to break up dark regions into many smaller regions so that they can be cleaned up by morphological opening. The threshold is set low enough so that it doesn't chip away parts of an image but only create holes in it. Hole filling is done to keep the skin image as single connected regions in anticipation of a second much larger morphological opening. Otherwise, the mask image will contain many cavities and holes in the image See "Figure 7".

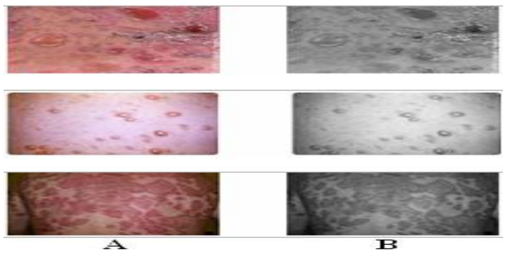


Fig. 6: (A) original Skin images, (B) Gray Skin Images

A. Applying the Open Operation, at this stage in the flow or our detector we have successfully removed the vast majority of the original pixels from consideration, but we still see little specs throughout the masked image. The open (erode & dilate) operation was performed using a 3x3 window of all 1s. It is seen that the open operation has resulted in there being a huge reduction in the number of small"noisy" specs. [8].

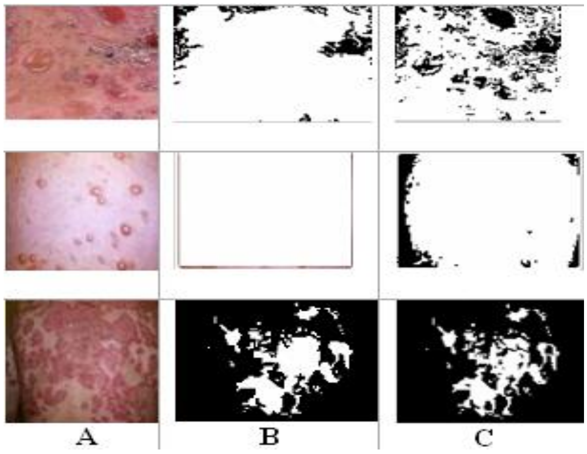


Fig. 7: (A) original Skin image, (B) Intensity threshold, (C) Hole filling

Morphological opening is performed to remove small to medium objects that are safely below the size of a Skin. A disk shaped structuring element of radius 5 is used. Morphological Dilating is in general, causes objects to dilate or grow in size; erosion causes objects to shrink. The amount and the way that they grow or shrink depend upon the choice of the structuring element. Dilating or eroding without specifying the structural element makes no more sense than trying to low pass filter an image without specifying the filter disk shaped structuring element of line se1 = strel ('line',11,90) is used. Figure 8 shown. Morphological Open and Dilating Operations.

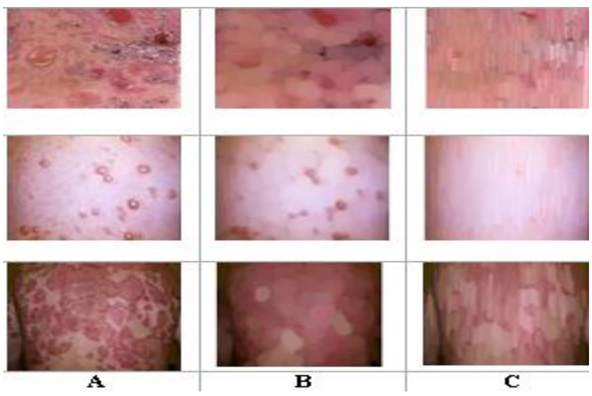


Fig. 8: (A) original Skin image, (B) Morphological Open Operation, (C) Dilating Operation.

5. CONNECTED COMPONENTS ANALYSIS

The next step is to remove small objects and connected the connected components for skin image that have fewer than P pixels, producing another binary image .The default connectivity is 8 for two dimensions. We used the statement BW2 = bwareaopen(BW, P, conn) to specify the desired connectivity "Figure 9" shown desired connectivity.

Where variable conn can have Value for Two-dimensional connectivity [12] [13] [14]:

A) 4 if 4-connected neighborhood

B) 8 if 8-connected neighborhood

The 1-valued elements define neighborhood locations relative to the central element of conn. Note that conn must be symmetric about its central element.

The basic steps for the desired connectivity are:

1- Determine the connected components:

CC = bwconncomp(BW, conn);

2- Compute the area of each component:

S = regionprops(CC, 'Area');

3- Remove small objects:

L = labelmatrix(CC);

BW2 = ismember(L, find([S.Area] >= P));

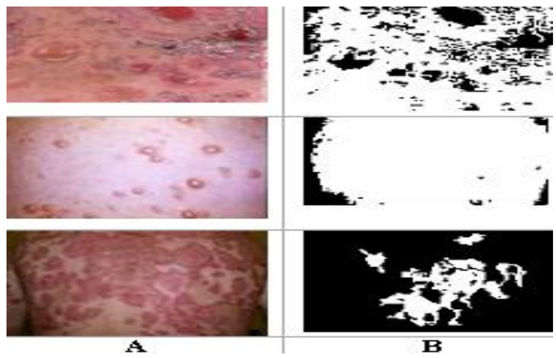


Fig. 9: (A) original image, (B) The desired connectivity.

The next step we find connected components in binary Skin image .The basic steps in finding the connected components are:

1- Search for the next unlabeled pixel, p.

2- Use a flood-fill algorithm to label all the pixels in the connected component containing p.

3- Repeat steps 1 and 2 until all the pixels are labeled

There are four fields structure for components:

1-Connectivity: Connectivity of the connected components (objects)

2-ImageSize: Size of image

3-NumObjects: Number of connected components (objects) in image

4-PixelIdxList: 1-by-NumObjects cell array where the k_{th} element in the cell array is a vector containing the linear indices of the pixels in the k_{th} object.

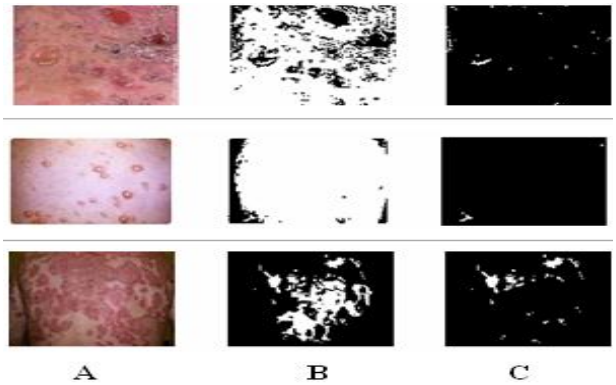


Fig. 10: (A) original Skin images, (B) connected components, (C) objects

Image segmentation is the process of partitioning /subdividing a digital image into multiple meaningful regions or sets of pixels regions with respect to a particular application [2]. The segmentation is based on measurements taken from the image and Measure properties of image regions shown in "Figure 11" for three images in "Figure 10".

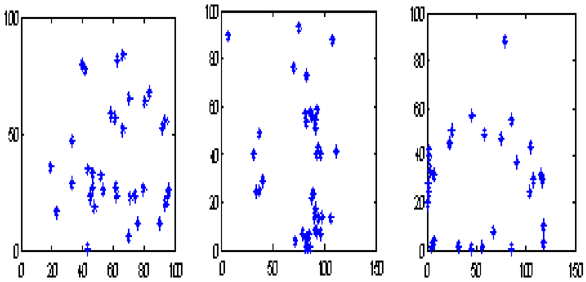


Fig. 11: Measure properties of three images regions

6. TEMPLATE MATCHING

The goal of edge detection is to produce something like a line drawing of an image. In practice we will look for places in the image where the intensity changes quickly. In general, the boundaries of objects tend to produce sudden changes in the image intensity. For creation of ear template, all types of the ear are considered to obtain a good representative template colors or hues and this causes the image intensity to change as we move from one object to another [9]. Might be grey level, color, texture, depth or motion. The result of image segmentation is a set of segments that collectively cover the entire image. All the pixels in region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions differ with respect to same characteristics. Edge detection is one of the frequently used techniques in digital image processing [10].

It is also possible that some pixels are missing within regions of a face because the segmentation was too strict, thus removing some pixels which are actually real skin. We end up with a much cleaner image after performing these operations. The subsequent step will perform various feature checks and gradient matching to finally confirm whether or not a particular region is Skin image [11].

The accuracy of this algorithm is quite good. Results of Skin Color Based Skin Image Detection in HSV Color Space. Experiments show that HSV color space is also good in classifying the skin color region [14].

7. EXPERIMENTAL RESULTS

In this section a detailed experimental comparison of the above stated algorithms has been presented. We have used two color image databases:

1. Database prepared in our conditions, images obtained from in Al-Sder Hospital.
2. Skin database and some other images obtained from internet.

The accuracy is obtained in all cases by using the following equation:

Accuracy =100 – (False Detection Rate +False Dismissal Rate) (2)

This stage is processed for each region at a time. The objective in this stage is to reject regions which have no holes as mentioned in the above region. The Euler number of an image is defined as the number of objects in the image minus the total number of holes in those objects.

There after analyze with several images, to decide that a skin region should have at least one hole inside that region. To determine the number of holes inside a region, we use the formula:

$$E = C - H \quad (3)$$

Where E=Euler Number, C=Connected component, H=holes. The next stage is conduct to template matching to cross correlation between template face and grayscale region.

The resulting image that we obtained after color segmentation would still contain some noise, which is made up of scattered skin pixels and maybe some

Arbitrary pixels of other objects that share similar tones to that of the skin.

Table 1. Euler Number

Image	Euler Number
	-169
	-14
	15

"Figure 12" show (A): Original Skin Image, (B) Edge for Center Skin Image.

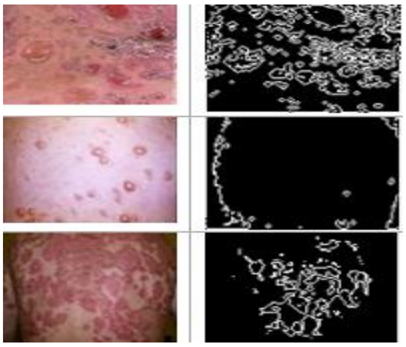


Fig. 12: (A): Original Skin Image, (B) Edge for Center Skin Image.

"Figure 13" shown (A) First Connected Component, (B) Second Connected Component ,(C) pemphigus Skin Image Detected Output.

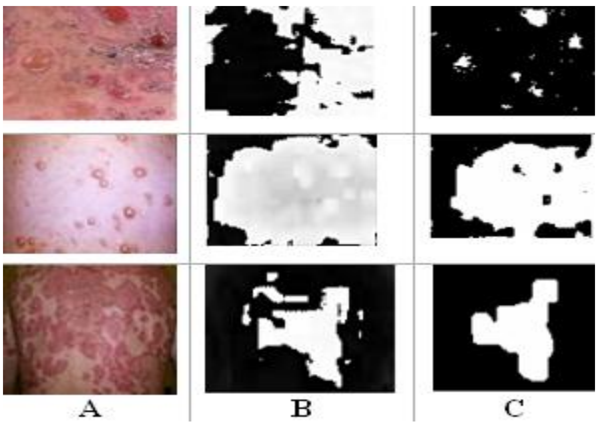


Fig. 13 :(A) First Connected Component, (B) Second Connected Component, (C) pemphigus Skin Image Detected Output.

8. CONCLUSION

From the results for our research, we are concluded that the edge detection using mathematical morphology is more efficient than the traditional methods. Where the main advantages of mathematical morphology is that it is easy to implant, give better results, less noise. and mathematical morphological operators can be implemented by using different morphological operators with different shapes and sizes of structuring elements as per requirement, Both objective and subjective e valuation and comparisons show the reliability o f the proposed operations also in noisy images while being of reduced complexity.

Final Detection Output The rectangle box to mark the detected Skin pemphigus diseases shown in "figure. 13". Once we get the skin image regions and crop them, it becomes possible to then convert it to a gray image of size 90 x110 pixels and save each as individual images for further processing for Skin pemphigus diseases recognition.

We use property of skin color to set threshold for removing some noises that similar to skin-color because the human skin tend to have a predominance of red and non-predominance of blue and we use morphologic opening operations to smooth, fill in, and remove objects in an image sequence. Finally, the object tracking process performs as memory for collecting skin-color objects obtained from previous frame to guide the next frame in order to remove skin-color pixels that immediately appear from frame to frame. The experimental results show the satisfying subjective test results. The run time error for face detection was 25 to 30 second while for Skin Image recognition it was between 40 to 60 seconds. Hence it can be concluded that the present algorithm demonstrate the super performance with respect to speed, zero repeats, low false positive rate and high accuracy.

Connected components Skin pemphigus diseases image edge detection is performed based on implicit morphological erosion with a significantly reduced number of computations.

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