Detection of Eczema DISEASE by using Image Processing

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Abstract: Because very bad weather in Iraq like elevated temperature, Smokes, dust, also increase depopulation to bad environment and increase the number of displaced, diseases have increased significantly including dermatological diseases and the most common types is eczema as a result of bad nutrition, bacteria, soils, bad food, and others factors. Because of all these environmental factors, physiological, chemical factors and others factors, became very necessary to detect skin diseases specially eczema and treated it to avoid aggravation the disease with the help of biomedical engineers, with less cost, and to prevent disease from spreading when at that it will be difficult and take long time to be treated.. So the aim of research is take an image to the infection area then process this image by MATLAB in many ways to obtain an image that can help the doctors in their work to recognize the eczema and the rate of infection and make it easy to improve and safe people life. Three lesioned layers are selected in this study, face layer, hand layer and foot layer, the study showed that the foot layer is more comfortable for detection the eczema in this approach technique.

Keywords: Eczema, MATLAB, Image processing, Skin disease

Introduction

For last decade and until now the skin disease is one of the widely distributed diseases specially the "eczema" and this ward means "to boil over," which is a Greek word. The eczema looks like red, inflamed, itchy patches that occur during flare-ups. This disease comes in three stages mild, moderate, or severe. Its location in the body appears in different places, eczema can be developed on the face of children and babies (especially the cheeks and chin), but any part on the body may be infected by eczema and symptoms may be different from one child to the next [Nedorost and Susan T 2012]. The Eczema is a disease infected the old and the younger people, but it goes away as the chilled became older, also other conditions are affected in it like environment and the person's health history and it may be appears as a reflexes for infected with other disease. Its symptoms begin as red places, then it will rise in a tiny blisters filling with a clear fluid atop red. When the blisters burst, the reddish skin will weep and ooze. In advanced eczema, which named as a chronic eczema, the blisters are less appearance and less oozing instead the skin will appears more thick , and more elevated, and larger. Eczema always and in the most time is very itchy and its itching is disturbing and very needy for scraping it and itching it, there are many types of eczema. A severe one which named topic dermatitis and the long lasting form which named a chronic eczema.[Oranj.AP etal,2002]

At the same time a person may have more than one type of eczema, or may be one type depending one Triggers and symptoms and treatment, beside that at the patient conditions, and these types we talking about could be either "atopic dermatitis.", or a chronic eczema. Therefore the importance is started here to

know which type or types that you are infected with, to know how to manage it and take the beast medical care.

The Major Features of Eczema are

The basic features and symptoms of eczema in infant Pruritis, Rash and extensors, and flexural in bigger children, the appearance of symptoms depend on the type of eczema its chronically relapsing, and on family history of other atopic disease, Dryness also other common features that may be appear. Facial pallor, Allergic shiners, Pityriasisalba, Icthyosis vulgaris, Keratosis pilaris, White dermatographism, Conjunctivitis, Keratoconus and cataracts, skin prick test positivity.

There is many types for eczema the best define for eczema is an inflammatory skin reaction to various exogenous and/or endogenous stimuli. Clinical presentation includes itching and sever rash which is appears in red nessspots, scaling and papulo vesiculation. This is for general but it comes in steps depending in many features that we talked about before like the patient history, his age immunity the type of skin and many other features. Beside the basic types there are many other sub types: which is named as Eczema / Seborrhoeic dermatitis, atopic dermatitis, Dyshidroticeczema , Discoid, nummular eczema / pompholyx, Contact dermatitis ,Varicose eczema , Asteatotic eczema[Agha HM etal,2016]. The specific causes of infected and cause eczema remains unknown, but it is believed that it happened and develop due to an environmental factors and a combination of hereditary (genetic) factors.

If a parent has had the disease eczema or another atopic disease, there children are more likely to develop it. And if both parent have an atopic disease, the chance increase further. The weather and other environmental factors especially the dust and strong sun light are also known to bring out the symptoms of Eczema. The major symptoms include: Irritant, Allergens, Microbes, Hot and cold temperature, Foods, Stress, and Hormones [McAleer etal, 2012]

The Treatments for eczema is treated depending on family physicians, but it is necessary to search for help from a health specialist since there are many causes of eczema and if we see there is no improving in healing.

The good careens for skin are the key if the eczema is mild, so the good care is all it need. If the eczema is from the severe type of eczema, it is definitely need to take medicine for it. So the basic steps for skin care are:
1-Soap and moisturizer. And Short, warm showers. Don't take very hot or very 2-long showers or baths. They can dry out your skin [Torley, D etal,2013].
3-Stress management. And 4-Get a humidifier.
For acute eczema the main treatment where there is significant weeping and oozing always herbal medicine is very perfect treatment in which using dilute solutions of vinegar or tap water and compress the area followed by evaporation. After that placing the infected part of the body in front of fan. As soon as the acute weeping has been shrinking, then treatment by steroid is not harmful and it could be an effective treatment. This treatment may be orally or by an injection (shot) [Kalliomäki, M etal 2010].

The medicines is differ depending on the case and the doctors the medicine used is one of several hormones may be get use and may be they not treat the case and some of these drugs are: Hydrocortisone, Antihistamines, Corticosteroids. The exposal patient to U.V therapy is an effective way. This may help if the skin condition is severe, to prevent eczema should avoid personal care products to allergy: skin contact with allergens such as soap, cosmetic, lotions, perfumes….ect, and Wear gloves when handling skin irritants. Wear cotton clothes control dust mite, maintain a home humidity level at 45-50% and at last avoid trigger foods [Torley, D etal.2013, Kalliomäki, M etal.2010].

Image Processing

Image processing is a software program in which it manipulating the image, and that for making an enhancement on the image and making it clearer and more understanding or to get some important information from it. So it is a type of signal processing when output may be image or characteristics or some image features and input is an image. The method of using image processing is one of the rapidly growing technologies in now days. It is considered a core or a center for research area within engineering and computer science.

Image processing basically includes the following three steps:

Input the image via image acquisition tools, then analyzing, handling and manipulating the image; and the final step is to get the Output which will be image or report based on the image analysis.

One of the best ways for dealing with Image processing can be simply done by using MATLAB software, Image Processing Toolbox in which this program MATLAB provides a global apps of workflow and algorithms for image analysis, processing, visualization, and developed algorithms. MATLAB provides performance of the image segmentation, image enhancement, noise reduction, geometric transformations, image registration, and 3D image processing.

Common image processing workflows can be automated by image Processing Toolbox apps. Segmentation of image data, compartment of image registration techniques and batch-process large data sets. The images, 3D volumes, and videos; adjust contrast; create histograms; and manipulate regions of interest can be explored (ROIs) by visualization functions and apps [F M Candocia.2006].

The best way for dealing with image processing is the manipulating and enhanced the image to achieve an aesthetic standard or supporting the reality. Anyway the translation between the human visual system and digital imaging devices can be definitely defined as a means of image processing. The world in the same manner cannot be perceived by the human visual system as digital detectors, additional noise and bandwidth restrictions are imposed with display devices [Y.L Kang etal.2004]. Because of all this, The development of the mathematical methods and algorithms to analyze and quantify biomedical data and cooperation it with other research for application of information analysis and visualization to biomedical research problems and development of the tools(in both hardware and software) our cooperation can be supported by giving the ability to analyze biomedical data to support the discovery and advancement of biomedical knowledge, these are considered the main goals of the image process technique [K. Wan etal.2004].

Methods and Algorithm

The algorithm consists of steps as shown below:

RGB to gray scale

Gray scale is an image in which the value of each pixel is a single sample, gray scale image are distinct from black and white images., A grayscale digital image is an image in which the value of each pixel is a single sample, that is, it gives only intensity information. The sort of these images, also known as black-and-white, are composed exclusively of shades of gray, changing from black to white , it's a white at the strongest intensity and black at the weakest .

Grayscale images are distinct from one-bit bi-tonal black-and-white images, these images have only two colors, black and white which in the context of computer imaging. In between. Grayscale, Grayscale images have many shades of gray , the result of measuring the intensity of light at each pixel in a single band of the electromagnetic spectrum are often the grayscale images ,and in such cases when only a given frequency is captured they are monochromatic proper. Grayscale images also can be synthesized from a full color image; see the section about converting to grayscale [Houcque.2005].
A (digital) color image is a digital image in which each pixel includes color information. For visually acceptable results, it is important to provide three samples (color channels) for each pixel, in some color space they are interpreted as coordinates. In computer display, The RGB color space is commonly used. In a color image each pixel has three values (or channels) and they measure the chrominance and intensity of light. The brightness information in spectral band is considered the actual information stored in the digital image data [Houcque.2005].

Converting RGB to gray scale

The main reason is that you either want to process the brightness information of an image, for example doing edge detection, or you want to do something with the color information, for example comparing if an object is colored in the same image as on another image. To do that you need to separate the brightness information from the color information, which is mostly done by using an RGB to gray scale. In the latter color spaces it is a lot easier to compare colors than in RGB.
*Therefore the processors prefer the gray scale more than the color space [T. Kumarm and K. Verma.2010].

Image Resizing

Resizing: This step is very important for increasing or decreasing the total number of pixel For standardization size of the image to avoid any error and to facilitate read and show the image in MATLAB. The scaling of images indicates to the resizing of a digital image digital imaging and in computer graphics . In video technology, the up scaling or resolution enhancement is known as the magnification of digital. The image can be scaled with no loss of image quality when an image is made up with scaling. A new image with a higher or lower number of pixels should be produced when scaling a raster graphics image, A visible quality loss is resulted from the decreasing the pixel number (scaling down). From the standpoint of digital signal processing [T. Kumarm and K. Verma.2010].

Image Denoising

When the image has a noise this noise can be considered a random variation of brightness or color information in images, and is usually an aspect of electronic noise. The sensor and circuitry of a scanner or digital camera are considered the main reasons of this noise. Image noise can be also produced in the unavoidable shot noise of an ideal photon detector and in film grain . Image noise adds spurious and extraneous information which is considered an undesirable by-product of image capture [M. Song etal.2010]. Types of image noise

1. Thermal Noise (additive Gaussian noise): Acquisition is considered the main sources of Gaussian noise in digital images e.g. poor illumination and/or high temperature, and/or transmission are considered the main reasons of the sensor noise .
2. Shot noise (random counts, Poisson noise): A statistical quantum fluctuations, that is, variation in the number of photons sensed at a given exposure level, is considered the main cause of dominant noise in the darker parts of an image from an image sensor . This noise is known as photon shot noise. Shot noise has a root-mean-square value proportional to the square root of the image intensity [M. Song etal.2010].
3. Salt-and-Pepper (replacement noise): An image containing salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions. This type of noise can be caused by analog-to-digital converter error [A. Gilat.2004].
4. Anisotropic noise: Orientation in images can produce this type of the noise, Row noise or column noise can be effected on the image sensors to cause this noise [www.mathworks.com, July 2010].
Image denoising is an important image processing task, the main properties of a good image denoising model is that it will remove noise while preserving edges [Lindsay MacDonald.2006].

Image filtering

Filters are using to remove the noise from the an image, convolution filters is considered a Linear filters , they can be represented using a matrix multiplication including some nonlinear operations such as thresholding and image equalization as is in the median filter[[Lindsay MacDonald.2006].
Image filtering is used to:- 1.Remove noise 2.Sharpen contrast 3.Highlight contours 4.Detect edge and other uses depending on the type of the filter[[Lindsay MacDonald.2006].

Median filter

Median filtering is used to remove the pepper and salts noise from the Images, it can be considered a nonlinear process. It is a very effective to remove the noise while preserving edges. The median filter works by replacing each value with the median value of neighboring pixels through the moving (pixel by pixel) in the entire image, "window" is a pattern of neighbors which slides, pixel by pixel over the entire image. The median value can be computed through the sorting all the pixel values from the window into numerical order, and then the pixel being considered will be replaced by the middle(median)pixel value[[Lindsay MacDonald.2006].

Image Enhancement

Image Enhancement: Is the process of digitally manipulating a stored image using software. The principle of image enhancement techniques is to process an image so that the result is more suitable than the original image.

The aim of image enhancement is to improve the interpretability of information in images for human viewers. Image enhancement techniques can be divided into:
1-spatial domain method which depends on pixels 2-Frequency domain method which depends on the Fourier transform.

Enhancement of (contrast): the contrast factor has the large importance for evaluation of the image equality, the contrast is resulted from the luminance diversity that reflected from two surfaces. Contrast makes an object distinguishable from other object and the background [Alan C.Bovik.2005].

Features extraction

Feature extraction means that the extraction of unique features from the processed lesion images. The complexity of classification problems in processed images can be reduced by this method. The affected area can be distinguished from background through a certain features like geometry and color.
Feature extraction has a very important role to increase the accuracy of the results in biomedical image processing, it is a necessary step to increase the quality of the processed image. However, to improve the quality of image, the image enhancement algorithm can be used to enhance the image, contrast, brightness adjustment [Joseph G etal.2006].

Image Segmentation

Is the process of dividing the image into several segments in order to change the representation image into form that is more meaningful and easy to analyze [M. Dalwadi.etal.2013].
*Steps of Segmentation by using K-means clustering are:-
Step (1): Image read.
Step (2): The image conversion from RGB color space to L*a*b* color space:-The image that we use it contain different color in order to distinguish these colors it is necessary to convert image from color space to L*a*b* space which consists of a luminosity layer L, chromaticity-layer a* and chromaticity-layer b*, All of the color information is in the a* and b* layers.
Step (3): Classify the colors in a* b* space using K-mean clustering:-
Clustering is a method of dividing the data into a number of clusters, it used when the data is without defined groups ,the aim of this algorithm is to find groups in the used data, Then the image will be clustered into 3 clusters by using the Euclidean distance metric.
Step (4): create an array to store the results of the clustering and choose the clustering containing ROI which will be converted to gray scale and then create GLCM

ROI

It means the region of interest which is the region that contains the selected subset of samples within a set of data identified for a particular purpose[Nedorost and Susan T 2012]. In many application areas the concept of a ROI is commonly used. A region of interest (ROI) is a piece of an image in which the filtering process or other operation can be performed on. More than one ROI in a one entire image can be defined. [www.mathworks.com]

GLCM

The graye Level Coocurrence Matrix (GLCM) method is a way in which the second order statistical texture features can be extracted. A GLCM is a matrix in which the number of gray levels and the number of columns and rows are equal, in the image. The matrix element A (a, b | Δc, Δd) of two pixels with relative frequency, these pixel are separated by a pixel distance (Δc, Δd), this matrix of a given neighborhood is occurred, one with intensity 'a' and the other with intensity 'b' [P. Mohanaiah etal.2013].
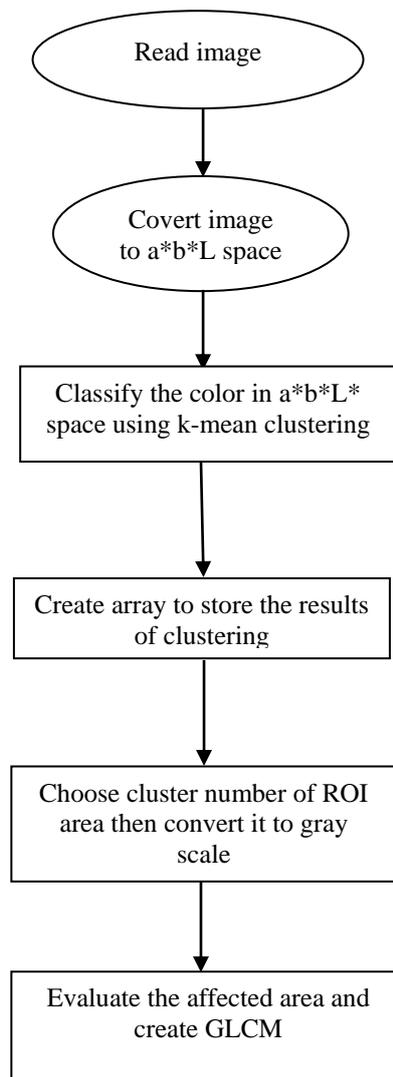
```
            ┌─────────────────┐
            │   Read image    │
            └─────────────────┘
                     │
                     ▼
            ┌─────────────────┐
            │  Covert image   │
            │ to a*b*L space  │
            └─────────────────┘
                     │
                     ▼
        ┌───────────────────────────┐
        │ Classify the color in a*b*L* │
        │ space using k-mean clustering │
        └───────────────────────────┘
                     │
                     ▼
        ┌───────────────────────────┐
        │ Create array to store the results │
        │      of clustering        │
        └───────────────────────────┘
                     │
                     ▼
        ┌───────────────────────────┐
        │ Choose cluster number of ROI │
        │ area then convert it to gray │
        │           scale           │
        └───────────────────────────┘
                     │
                     ▼
        ┌───────────────────────────┐
        │ Evaluate the affected area and │
        │       create GLCM         │
        └───────────────────────────┘
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Figure 1. Block diagram of image segmentation

I/p image → Read image → im-show → Convert image to gray scale

Denoising
Median filter

← Resize

Image Enhancement
Adjustment image
↓
Imshow image

Segmentation

Read image → Convert to gray scale
↓
Classify the color in a*b*L* space using K-mean clustering
↓
Store the result clustering and choose cluster contain ROI, and create GLCM

Feature extraction
separate object from background

Figure 2.General block diagram of proposed technique

Results and Discussion

Approach technique was applied on three different skin layers, face, hand and foot layers were selected to detect and study the eczema disease on skin of these three different layers from the human body.

Three images of each layer were selected to use in this study, these images were taken from volunteers infected with Eczema, then these images were pre-processed by using image processing technique as shown in general block diagram of approach technique. After image process technique, image segmentation technique was applied on these image data by using K-mean clustering, then the cluster that has the region of interest (ROI) will be selected as shown in fig.1 and figure2.
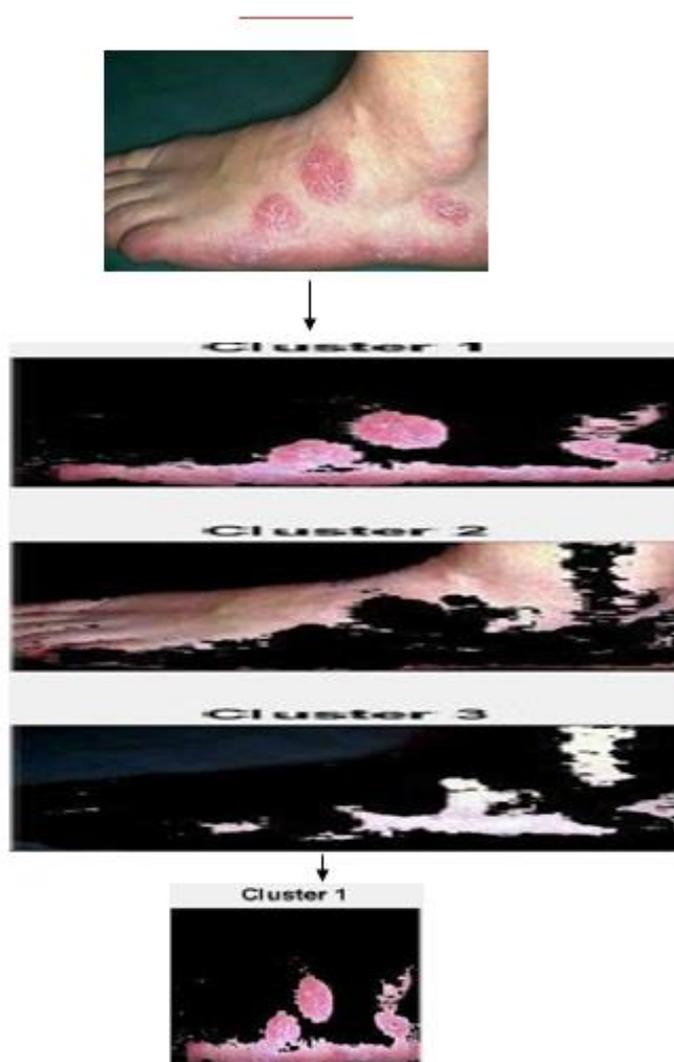
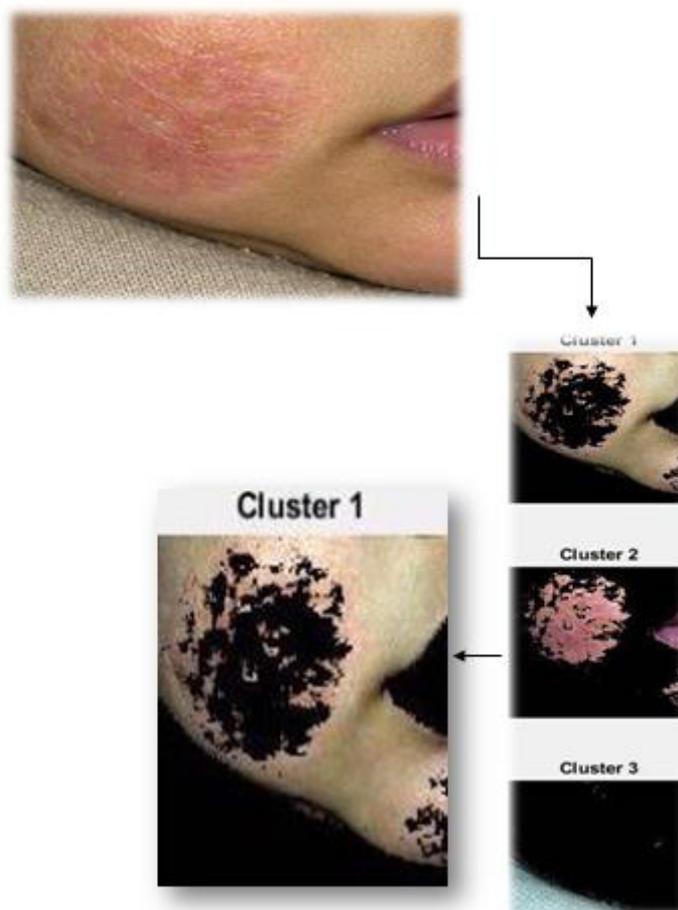Figure 3. Choosing ROI cluster in the foot layer

Figure 4. Choosing ROI cluster in the face layer

After choosing ROI cluster, the features of this cluster was extracted and calculated.
The main features extraction were selected to study as following
1. Affectedarea:It is the area of skin that containing the infection.
2. Contrast: is the difference between maximum and minimum pixel intensity in image.
3. Correlation: Refers to a linear shift time invariant relationship between any two neighbor pixels in the image.
4. Energy:Energy is defined based on a normalized histogram of the image. Energy shows how the gray levels are distributed. When the number of gray levels is low then energy is high.
5. Homogeniaty:Measure of similarity or uniformity of gray level with in region in the image.
6. Mean:Represents the average value of set of pixels .
Standard deviation: Refers to how much variation exists from the mean value.
7. Entropy: Refers to how much information containing in the image
8. Variance: describe the probability distribution by measuring of how far a set of pixels is spreading out from the mean value.
9. Skewness: use to make a judgment in the surface of an image.
10. Kurtosis: It is often considered as a measure of sparsity of the image.

Fig (3, 4) shows the distribution of eczema in skin of face layer of different three persons.
Table-1 shows the results of feature extraction of infected skin in the face layer

Figure 5. Face Image after choosing cluster with ROI

Figure 6. Face Image after choosing cluster with ROI

Figure 7. Face Image after choosing cluster with ROI

Table 1. The results of features extraction of infected skin in the face layer

parameters	Fig(4.5)	Fig(4.6)	Fig(4.7)	Average value
Affected area	46.954	50.4558	54.9714	50.7937
contrast	0.9816	0.7996	0.9942	0.92513
correlation	0.8596	0.9280	0.9085	0.8987
energy	0.2846	0.2514	0.1999	0.2453
homogeneity	0.9288	0.9194	0.8977	0.9153
mean	56.0075	75.2324	83.7614	71.667
std	67.3785	80.9849	80.6263	76.3299
entropy	4.5385	4.8004	5.3139	4.2842
variance	4.1019e+03	5.0718e+03	5.5423e+03	4.905e+03
kurtosis	2.1574	1.6703	1.4004	1.7427
skewness	0.7461	0.4431	0.3697	0.5196

Fig (5,6,7) shows the distribution of eczema in skin of hand layer of different three persons.
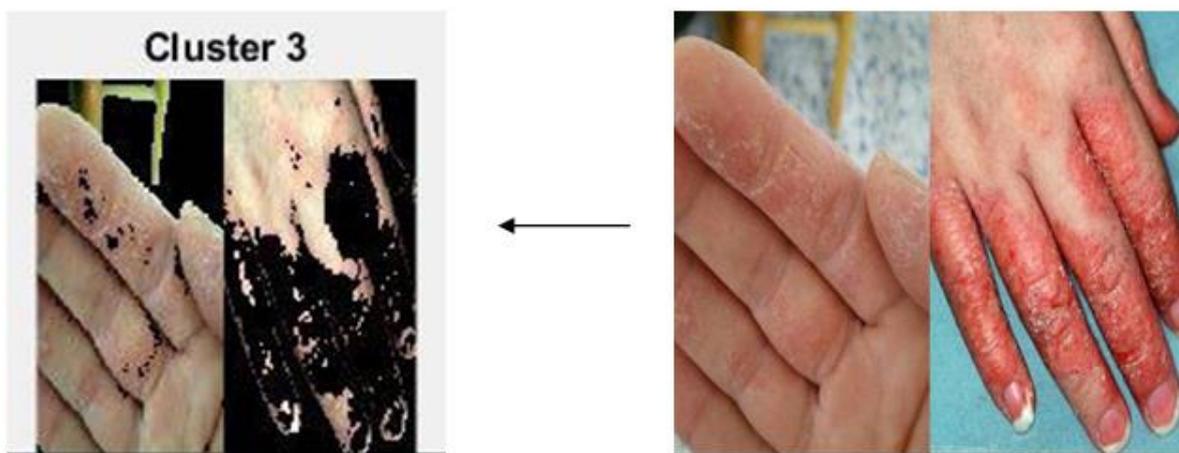Table-2 shows the results of feature extraction of infected skin in the hand layer

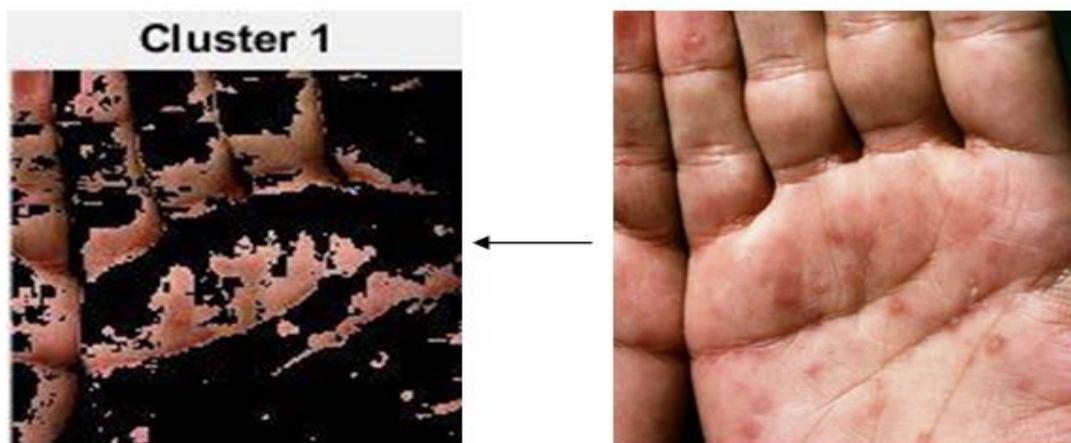Figure 8. Hand Image infected with eczema
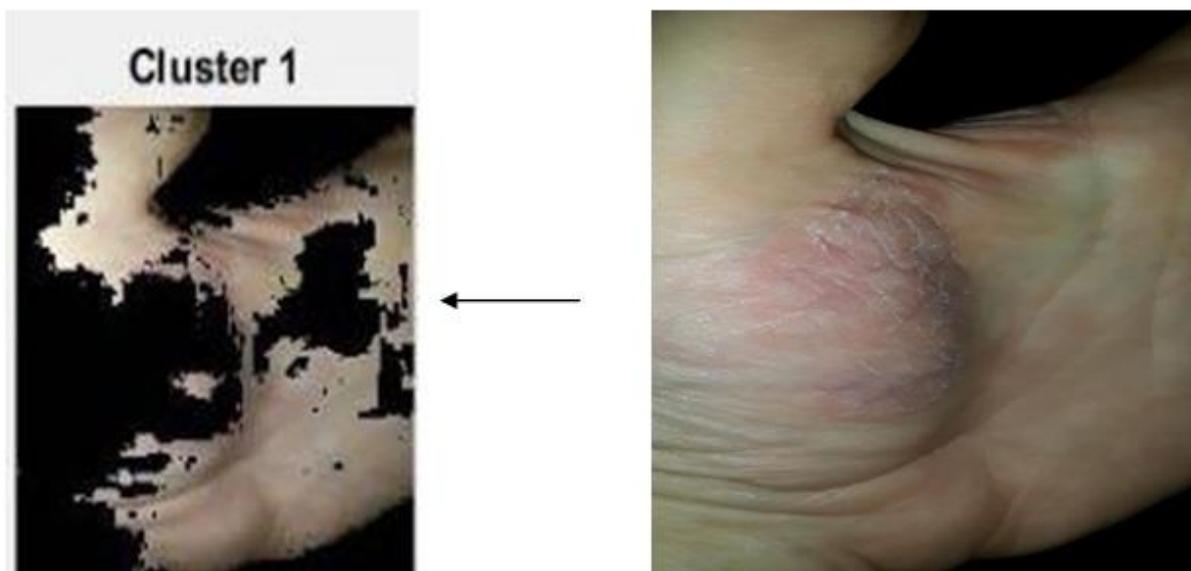

Figure 9. Hand Image infected with eczema

Figure 10. Hand Image infected with eczema

Table 2. Shows the results of feature extraction of infected skin in the hand layer

parameters	Fig.(4.8)	Fig.(4.9)	Fig.(4.10)	Average value
Affected area	64.698	17.5537	43.6859	41.9792
contrast	1.5935	0.8989	0.9932	1.1618
correlation	0.8697	0.8337	0.9235	0.8756
energy	0.1686	0.4307	0.3280	0.3091
homogeniaty	0.8724	0.9316	0.9464	0.9168
mean	11.7704	37.7889	80.8234	43.4609
std	90.3369	61.1987	92.5032	81.346
entropy	5.5609	3.4140	4.3994	4.4581
variance	5.4504e+03	3.2824e+03	7.9760e+03	5.5696e+03
kurtosis	1.3996	3.5058	1.4943	2.133
skewness	-0.1632	1.3592	0.4463	0.5474

Fig (8, 9, and 10) shows the distribution of eczema in skin of hand layer of different three persons.

Figure 11. Foot image after choosing cluster of ROI

Figure 12. Foot image after choosing cluster of ROI

Figure 13. Foot image after choosing cluster of ROI

Table -3: Shows the results of feature extraction of infected skin in the foot layer

parameters	Fig(4.10)	Fig(4.11)	Fig(4.12)	Average value
Affected area	15.2881	14.653	15.0201	14.987
contrast	0.8342	0.5024	0.6409	0.6591
correlation	0.9412	0.9298	0.9182	0.9297
energy	0.2918	0.4031	0.5972	0.4307
homogeniaty	0.9546	0.9686	0.9550	0.9594
mean	83.3903	44.0921	37.2528	54.9117
std	91.3877	68.5514	73.6490	77.8627
entropy	4.5785	3.8074	2.3735	3.5864
variance	6.7652e+03	4.4708e+03	4.8297e+03	5.3552e+03
kurtosis	1.3870	3.2072	3.9967	2.8637
skewness	0.3603	1.2805	1.6356	1.0921

Fig (11, 12,13) shows the distribution of eczema in skin of hand layer of different three persons.
The average value of each feature in all layers was calculated to simplify study of results, it can be shown that the effected infected area in the face layer is larger than both hand and foot layer, also it can be shown that the hand layer is more contrast than both face and foot layers, the contrast of face layer is more than the foot layer. it is clearly that the foot layer is relatively moore correlated than both face and hand layers, also the energy of foot layer is higher than both face and hand layers. The homogeneity of fool layer is relatively higher than both face and hand layers, it can be seen that the entropy in the face layer is relatively higher than both hand and foot

layers, also it can be shown that the variance and standard of deviation in the hand layer is higher than both face and foot layers, it obviously that the kurtosis in the foot layer is higher than the face and hand layers, it is clearly that the foot layer has a higher skewness than the hand and face layers

Conclusion

It can be concluded that the face layer is infected by eczema higher than the hand and foot layers because the skin of the face is more sensitive than the rest when it subjected to external environment factors and pollution, so the face layer image has a more entropy than the rest layers. The hand layer image has the best contrast but it's pixels data are spreading out over a large range of the value then it has a higher probability distribution than the rest layers, all layers have a high positive correlation but the foot layer is more correlated, the foot layer image has a low gray level but the best compressibility ,because a good homogeneity , the foot layer image has the better uniformity of gray level than the rest layers, the foot layer image has a longer and sharper peak distribution than the rest layers, the foot layer image has a good asymmetry of probability distribution than the rest layers, it can be concluded that the foot layer detection is more comfortable in this approach technique.

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