Skin Disease detection based on different Segmentation Techniques

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Abstract— **The outer integument of the human body is skin. The skin pigmentation of human beings varies from person to person and human skin type can be dry, oily, or combination. Such a variety in the human skin provides a diversified habitat for bacteria and other microorganisms. Melanocytes in the human skin, produces melanin which can absorb harmful ultraviolet radiation from sunlight which can damage the skin and result in skin cancer. The necessary tools needed for early detection of these diseases are still not a reality in most third world communities. If the symptoms of skin diseases such as acne, dermatomyositis, candidiasis, cellulitis, Scleroderma, chicken pox, ringworm, eczema, psoriasis, etc. are left untreated in its early stage then they can result in numerous health complications and even death. Image segmentation is a technique which aids with the detection of these skin diseases. In this paper, image processing techniques like adaptive thresholding, edge detection, K-means clustering and morphology-based image segmentation have been used to identify the skin diseases from the given image set. The acquired image set was pre-processed by deblurring, noise reduction and then processed. Depending on the definite pattern (pertaining to a distinct disease) present in the processed image the disease is detected at the output for a corresponding input image.**

Keywords— chicken pox, eczema, psoriasis, ringworm, k means, adaptive, morphology, edge detection

I. INTRODUCTION

In India the prevalence of skin diseases is about 10 to 12 percent of the total population. The skin provides the body with protection and receives sensory stimulus from the outer environmental factors. It consists of seven layers of ectodermic tissue and protects bones, muscles and internal organs, making it the largest organ of the human body [1]. The factors stimulating skin diseases are- poor hygiene, increased levels of pollution, global warming and the harmful UV rays. A two to three percent increase in tumors can be caused just due to a one percent ozone depletion. Photosensitive skin diseases and infectious skin diseases are quite common in India. It is very important to treat them at their earliest or else it might lead to complications that not only affect the skin but also the mental health and life of the individual [2].

People need effective solutions for the following reasons-

- The population of India is ever increasing and proper treatment of every individual at a faster rate is very important.
- Skin diseases can be comparable to diseases like tuberculosis, AIDS etc. that cause mortality if not treated immediately.
- Treatment of even a small skin disease of an individual gets limited due to the economic cost. Therefore, pocket friendly yet accurate methods of skin disease detection are important.

Dermatology is the branch of science that deals with the diagnosis and treatment of skin diseases, hair and nail and a trained medical expert in this field is called a dermatologist.

In today's world, almost all the sectors be it medicine or any other field, get the aid of computerized systems in order to replace the use of manual traditional equipments with automated systems. With so many types of skin diseases, all the modern researchers especially in medical science are looking for a solution that could successfully assist doctors using modern technology in detecting a particular disease at its earliest stage of diagnosis without consuming much time [3]. This is where digital image processing is very helpful.

Digital image processing involves processing a digital image with the help of computer algorithms to get an enhanced image by extracting some useful information. The three basic steps of image processing involve- importing the image via image acquisition tools; analysis and manipulation of the image; a report or output on the basis of

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the analyzation of the image. Image segmentation is the partitioning of an image into distinct regions containing pixels with similar attributes. It helps in the analysis and interpretation of the image in a simpler manner.

A handful of researches have been conducted to implement various techniques of image processing so that accurate results can be obtained. Based on texture analysis, an automated system was proposed by Arivazhagan et al [4] which could detect human skin diseases by the method of independent component analysis of the datasets. Guo and Liu worked on the detection of skin tumor, psoriasis and vascular dermatosis with the help of computed tomography [5]. Images related to any skin disease is mainly filtered for removing the unwanted hairs and the noise present on the skin which can be done with the help of various methods of feature extraction [6]. Research on detection of melanoma was done by Ganeshkumar and Vasanthi by pre-processing and edge detection [7]. Algorithm for improvement in recognition of skin pixels namely- RGB (Red, Green, Blue), chrominance, luminance and HSV (Hue, Saturation, Value) was proposed by Kolkur et al [8]. A system was proposed by Pravin S. Ambad and A. S. Shirsat where the system will process, and analyze the input image and classify to various diseases at the output [9].

The work presented in the paper is aimed at successfully detecting skin diseases like ringworm, eczema, chicken pox and psoriasis using different segmentation techniques. Accuracy of the feature measurement helps to decide the result of image segmentation [10]. This paper will help us to find the most suitable segmentation technique of the following to detect the above said skin diseases:

(1) Adaptive thresholding
(2) Edge detection
(3) K-means clustering
(4) Morphology based image segmentation

The above-mentioned methods are applied on the images of each of the four skin diseases using OpenCV with the help of python and the variations of the results of each dataset are observed.
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II. METHODOLOGY

The flow diagram of the present work is shown in Fig1. The methodology filtered with the de-noising filters begins with acquisition of the images followed by image processing and segmentation. In pre-processing, noise reduction is done by using average filter and the segmentation techniques used are - adaptive thresholding, edge detection, k-means clustering and morphology-based image segmentation.

A. Pre-processing

Contrast- Contrast enhancement has been applied on the images considered to increase the brightness or sharpness as and when required so that proper information can be obtained from the images.

Noise reduction- The images taken into consideration has been filtered with the denoising filter. In most of the cases salt and pepper noise is present and has been removed with the help of average filter.

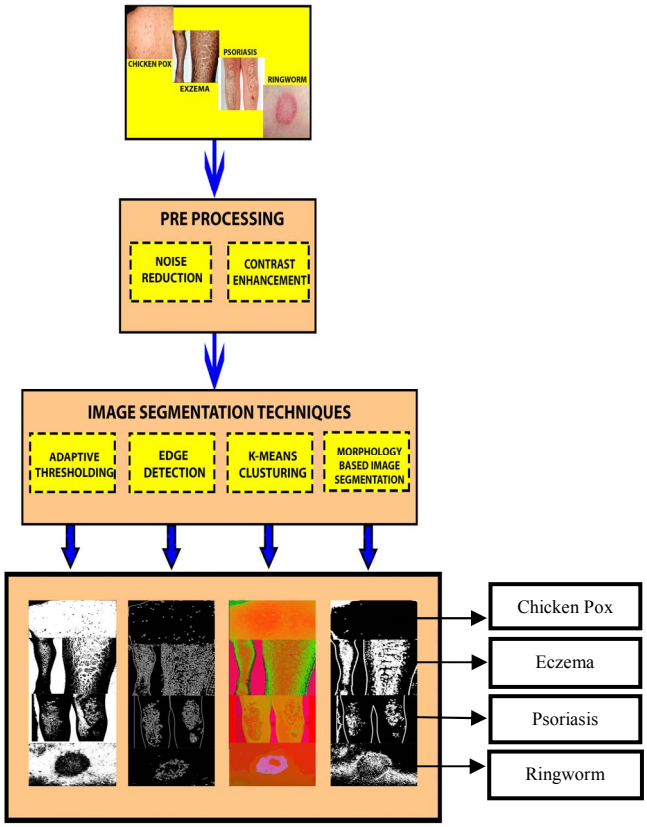

Fig. 1: Work flow diagram of the proposed work

B. Image Segmenation

A) Edge Detection: -

The filtered image is convolved with the selected operator's gradient with a referential axis. A threshold value is considered and Gaussian filter is used to blur the image and to remove noise and detail. For each pixel co-ordinate the gradient magnitude is computed and then the pixel co-ordinate is shifted to the adjacent co-ordinate. If the gradient magnitude is greater than the threshold value then the respective co-ordinate of the gradient magnitude is denoted as the 'edge'. Primarily the image is converted to the greyscale and then smoothened. Lastly edge detection is done.

From our experimental result, ringworm is best detected using edge detection technique. Biologically ringworm is a type of skin infection caused by mould like fungi which lives on the dead skin tissues. The infected region of the skin due to the presence of moisture and the skin texture is not detected by other segmentation process efficiently. But converting the diseased image to the greyscale and applying the

algorithm we can easily detect the ringworm around the skin using Edge detection segmentation process.

B) Adaptive Thresholding: -

The input image histogram is considered along with its expected background proportion. The intensity and image pixels are noted with the help of which quantile is calculated using-

$$q = argmin \sum_{i=0}^{j} h(i) \geq N.b$$

where, N is the total number of pixels……(i)

Two adaptive functions adaptive thresh mean and adaptive thresh Gaussian functions are used to calculate the thresholding value from the image which makes it easier to decide the neighborhood area. If the foreground is found non-empty, then the process is repeated. If the foreground is empty, then the pixels at the background are denoted.

Chicken pox is best detected by Adaptive thresholding. Separating the desired foreground image from the rest of the background primarily helps us in detecting the entire infected region of this disease while other segmentation methods cannot. In case of K means clustering, the detailing of the affected image is lost due to the presence of clusters while in case Morphology based segmentation and Edge detection the whole infected area is not detected.

C) K-means Clustering: -

A set of data points and a set of centers are considered in the image. Using the elbow method 4 cluster points are considered randomly from the image. The distances between each data point and cluster centers are recorded. Each time different set of data points are considered and the distances are measured. The set of records are compared and the respective set of data points resulting in the minimum distance has been selected.

It is seen that Eczema is well distinguished by K means method of segmentation. The patches on the skin due to inflammation and itchiness are generally referred as Eczema. While comparing the different segmentation process, the swollen region is not efficiently detected using other segmentation processes like in adaptive thresholding the output image becomes too dark and for morphological method the output is found to be losing information from the image.

D) Morphological Segmentation: -

The input image is considered to be a set of data. The resultant set is complemented and structured. Initial points inside the boundary of each structure are recorded. Then union of the complemented and original set of data is determined.

From our experimental result Psoriasis was best detected using Morphological based technique. Psoriasis is a type of chronic skin condition which is caused by an overactive immune system. While using the edge detection process only the edges around the infection skin is detected but the infected region is not efficiently detected. Besides, in K means clustering and adaptive thresholding methods, certain information is being discarded due to the presence of noise and the resultant output image is blurred.

III. Experimental Results

The experimental results are shown below for the input images of the diseases- Chicken Pox, Eczema, Psoriasis, Ringworm and the corresponding obtained output images obtained for the different segmentation techniques used namely Adaptive thresholding, Edge detection K- means clustering and Morphological segmentation.

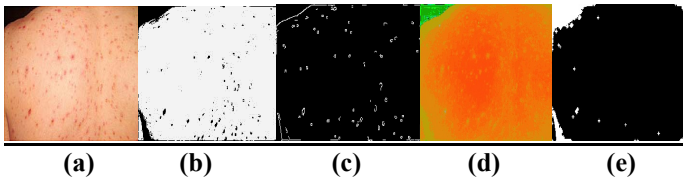

Fig. 2: (a) Input image (Chicken Pox); (b) Image after Adaptive thresholding; (c) Image after Edge detection;
(d) Image after K- means clustering; (e) Image after Morphology based image segmentation

In Fig. 2: Chicken Pox affected image is considered and the segmentation techniques are applied. Fig.2(b) is showing the result of the output segmented image using adaptive thresholding. 2(b), 2(c), 2(d) and 2(e) are showing the results of edge detection, K-means and lastly the morphological segmentation.

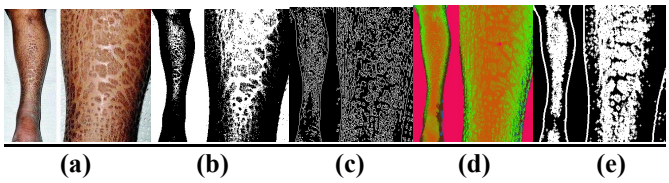

Fig. 3: (a) Input image (Eczema); (b) Image after Adaptive thresholding; (c) Image after Edge detection; (d) Image
after K- means clustering; (e) Image after Morphology based image segmentation

In Fig 3: Eczema affected image is considered and 3(b), 3(c), 3(d), 3(e)are the segmented images after Adaptive thresholding, Edge detection, K-means clustering respectively.

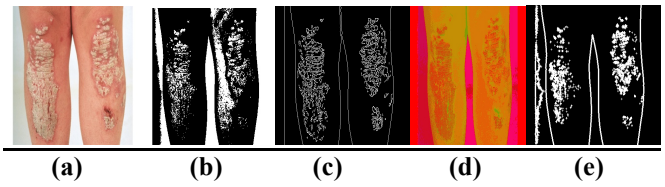

Fig. 4: (a) Input image (Psoriasis); (b) Image after Adaptive thresholding; (c) Image after Edge detection; (d) Image after K- means clustering; (e) Image after Morphology based image segmentation

The input image and corresponding output images with respect to the disease Psoriasis is given in Fig. 4. The output image after Adaptive thresholding is shown in 4(b), the output image after Edge detection is shown in 4(c); the output image after K-means clustering and Morphology based image segmentation are shown in 4(d) and 4(e) respectively.

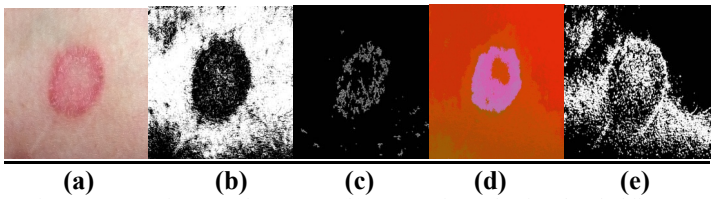

Fig. 5: (a) Input image (Ringworm); (b) Image after Adaptive thresholding; (c) Image after Edge detection; (d) Image after K means clustering; (e) Image after Morphology based image segmentation

The input image and corresponding output images with respect to the disease *Tinea corporis* (ringworm) is given in Fig. 5. 5(b), 5(c), 5(d) and 5(e) are showing the corresponding outputs after Adaptive thresholding, Edge detection, K-means clustering and Morphology based image segmentation respectively.

Conventionally, the ratio between the average signal value and the standard deviation of the background is denoted as the SNR ratio. In other words, a Signal to Noise ratio is determined as the ratio of the net signal to the RMS Noise. A Root Mean Square Noise is represented as the square root of the mean of variances from the background region. The following table is determined with the help of SNR values of the outputs of the disease infected images using segmentation techniques namely Adaptive thresholding, Edge detection, K-means clustering and Morphology based segmentation to find the results in terms of visibility.

Diseases	*Segmentation Techniques*			
	Adaptive	**Edge**	**K-means**	**Morphology**
Chicken Pox	**19.9684**	14.9575	9.9684	14.7455
Eczema	9.1405	7.0314	**12.246**	7.2193
Psoriasis	7.2082	10.2513	10.7983	**13.7961**
Ringworm	7.5957	**19.2816**	10.5685	8.2054

Table 1: Signal to Noise ratio using different segmentation techniques

Hence, from the segmented results obtained from the SNR parameters considered, it can be accounted that Chicken Pox can be best detected by Adaptive Thresholding, Eczema can be best detected by K means clustering, Psoriasis can be best detected by Morphology based image segmentation and Ringworm can be best detected by Edge detection.

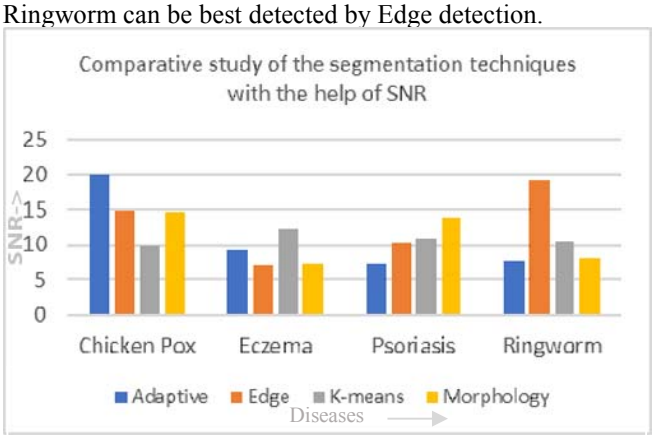

Fig 6: Skin disease infected images with respect to signal to noise ratio

IV. Conclusion

In this paper, we performed four segmentation techniques on certain skin diseases namely- eczema, psoriasis, chicken pox and ringworm, intending to be informative regarding the detailed information relative to the images. The proposed method improves the segmentation using OpenCV with the help of python in separating the image on the basis of edge detection or region detection. For the four different disease images, four segmentation techniques are used and the resultant images are produced on the basis of Signal to Noise Ratio. The segmentation techniques show promising results differently for the four categories of diseases. In case of chicken pox adaptive thresholding is the best method. For eczema k-means clustering is the best method. Morphology based segmentation is the best method for detecting psoriasis. In case of ringworm disease edge detection is the best method. However, at a large the applied segmentation procedure could be more efficient if it is coupled with the classification of the diseases, so as to act as a support to the clinicians for the analysis of the dermatologists.

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